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Electric Welding of High-Speed Steel and Stellite in Tool Manufacture

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Every user or buyer of cutting tools will be interested in this article, which shows a practical way to save an enormous amount of high-speed or other steel which is wasted annually. It also shows how new tools may be produced so as to use the high-priced steel only for the vital parts.

THE cost of solid high-speed cutting tools at the present time is very high. At the same time their remarkable cutting qualities make them a necessity in up-to-date shop practice. The electric process of butt-welding has made it possible to obtain all the advantages of a solid high-speed cutting tool and yet at a cost that is not a great deal higher than the ordinary tool-steel product. Stellite, which has recently become more widely known, has been rather limited in its use owing to the fact that it cannot be machined, and it has been thought by many that it could not be successfully joined to any other metal for holding it. This has limited its use to special forms of toolholders, which are often very clumsy in getting into difficult corners on special shapes. The electric process of butt-welding has made it possible to join Stellite bits of any common size and shape to a shank of ordinary steel, giving all the advantages of a solid cutting tool and yet employing only a small amount of the Stellite metal just where it is needed for cutting.

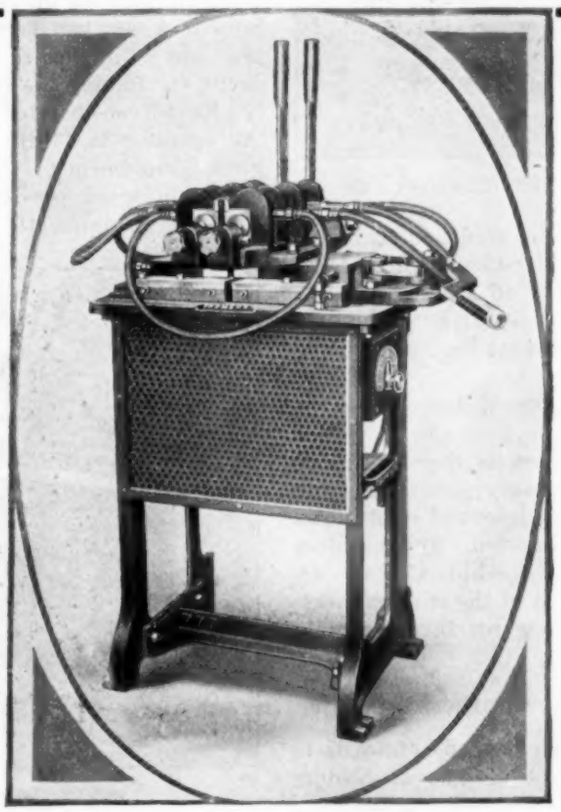


FIG. 1. THOMSON 10-A6 BUTT-WELDING MACHINE

The Thomson welding process consists of passing a large volume of electric current at a low pressure through the joint made by butting two pieces of metal together. The electrical resistance of the metals at the contacting surface is so great that they soon become heated to a welding temperature. Pressure is then applied mechanically and the current turned off, thereby producing a weld. The metal is in full view of the operator at all times instead of being hidden by the coal of a forge or by flame in an oil furnace. No smoked glasses or goggles are required any more than would be if welding by the forge method. Due to the way the metal is forced together there is no oxidation such as there would be in an open fire and therefore no welding compound is ordinarily required. It is this feature alone which makes it possible to weld high-speed steel and Stellite, the former being very difficult to weld by the forge method and the latter practically impossible. With this process of electric welding the heat is first developed in the interior of the metal. Consequently, it is welded there as perfectly as at the surface. When welding with other methods, however, the outer surface is heated first and very often the interior part does not reach welding heat, the result being an imperfect weld. There is no blistering or burning of the stock when welding electrically, whereas it certainly requires a very expert welder indeed to secure the proper heat on high-speed steel in a forge fire without burning at some point. The process is the most economical known, due to the fact that no energy in the form of heat is being wasted in heating more of the material than is required to make a weld and as soon as it has been completed the current is turned off so that the machine then is not using up any energy whatever. The operator has complete control of the current at all times so that he can obtain any color desired on the metals, which are always visible, and waste by accidental burning of metal is reduced to a minimum.

The only preparation of stock necessary for welding by this process is that when very rusty or greasy it should be thoroughly cleaned, as the presence of either rust or heavy grease affords poor contact with the copper clamping jaws, retarding the flow of electricity and seriously reducing the heating effect.

It is often asked if the electric current has any effect on the welded metal. This question arises from the fear

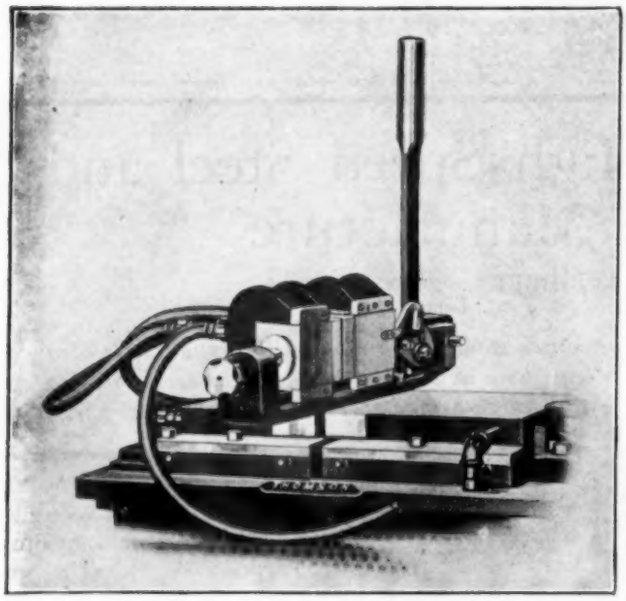


FIG. 2. CLOSEUP VIEW OF LEFT-HAND CLAMP

that there may be some mysterious condition connected with electricity that will change the characteristics of the metal, particularly of high-speed steel or Stellite. The answer is, of course, in the negative, as the only effect of the electric current is to heat the metals being welded.

The rapidity of work will depend largely on the operator, the size and shape of the pieces to be welded and the size of machine being used, as there is a wide range in welding time between heavy pieces requiring careful alignment in the clamping jaws and light pieces which can be rapidly and easily handled. The machines made by the Thomson Electric Welding Co. are designed to get the maximum output at the minimum cost for labor and current. In other words they are high-efficiency machines.

Welding High-Speed to Low-Carbon Steel

In tool welding there are various kinds of welds to be made, which require different designs of holding jaws and often two distinct types of welding machine.

Three butt-welding machines shown in Figs. 1, 3, and 4 are especially suitable for welding drills, reamers or other tools that can be made up of a combination of high-speed and low-carbon steel. The machine shown in Fig. 1, known as the 10-A6 machine, will weld iron or steel rods from $\frac{1}{4}$ to $\frac{3}{4}$ in. in diameter, or an equivalent cross-section in squares, rectangles or flats. An operator can make from 50 to 200 welds per hour, according to the size and nature of the work being handled. The clamps are of the horizontal operating type, adjustable for different sizes of stock as well as for horizontal alignment of the work. A close-up view of the left-hand clamping mechanism is shown in Fig. 2. The jaw blocks are water cooled and have a maximum movement of $1\frac{1}{2}$ in. by means of the hand-operated clamping levers. There is also a possible $\frac{3}{4}$-in. adjustment of both front and rear jaw blocks. Stops are provided for backing up the work. There are four copper jaws to a set, two being used on each clamp. These jaws are $2\frac{1}{2}$ in. square by $1\frac{7}{16}$ in. thick. The pressure device for forcing the heated ends of the work together is a hand-lever-operated toggle movement, which enables the operator to "feel" his work. This toggle device gives a movement of 1 in. to the right-hand jaw. The maximum space possible between the jaws is $3\frac{1}{4}$ in. There is an automatic current cutoff mounted on the machine. The standard windings are for 220, 440 and 550 volt, 60-cycle alternating current. The current variation for different sized stock is effected through a five-point switch mounted on the machine. Standard ratings are 15 kw., or 25 k.v.a., with 60 per cent. power factor. This size of machine covers a floor space 43 x 57 in., is 65 in. high and weighs about 1100 pounds.

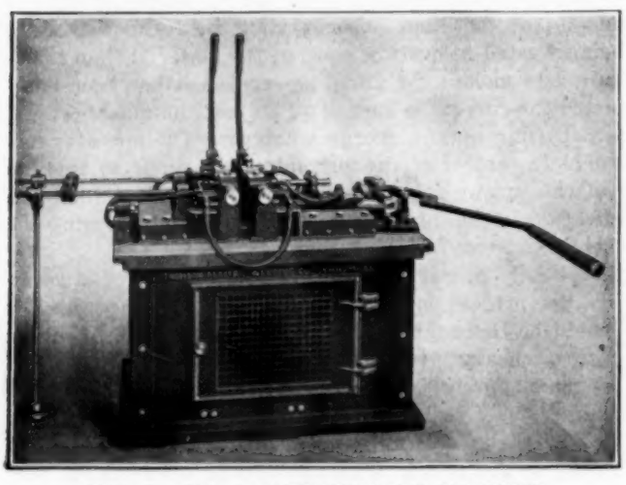


FIG. 3. NO. 6 BUTT-WELDING MACHINE

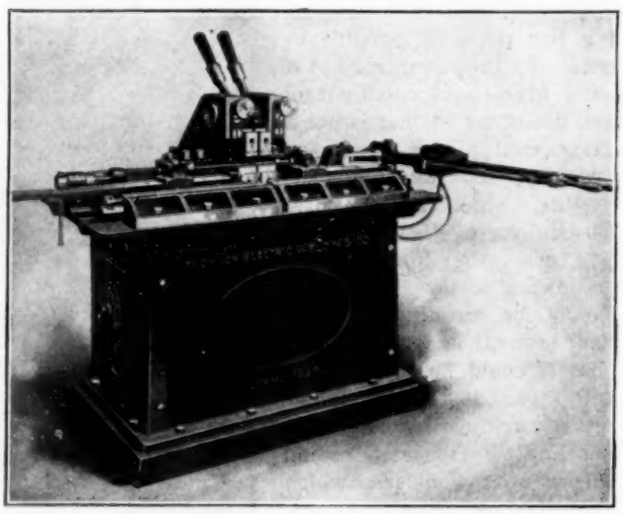


FIG. 4. SPECIAL 5-D MACHINE

The machine shown in Fig. 3, or the No. 6 machine, is for heavier work, its capacity being from $\frac{1}{4}$ to 1 in. in diameter on iron or steel rods, or the equivalent in other shapes. Its production is from 50 to 125 welds per hour. The maximum jaw opening is 3 in.; the four jaws are of hard-drawn copper, $2\frac{1}{2}$ x $2\frac{3}{4}$ in. and $1\frac{1}{4}$ in. thick; toggle-lever movement $1\frac{1}{2}$ in.; maximum space between jaws, 4 in.; current standards are the same as for the previous machine. There are 10 points of current variation for different sized stock, effected through double-control switches mounted on the machine. Standard ratings are 30 kw. or 45 k.v.a., with 60 per cent. power factor. The jaws are air cooled, but the copper

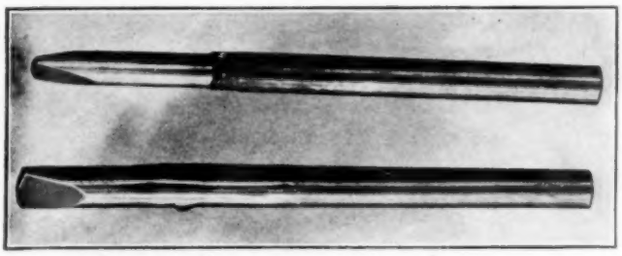


FIG. 5. STELLITE-TIPPED ROUGHING DRILLS

slides to which the jaws are bolted, as well as the secondary copper casting of the transformer, are water cooled. It occupies a floor space 22 x 44 in. and the height to center line of the jaws is 37½ in. The weight is 3100 lb. Its operation is practically the same as the first machine described.

Another machine of very similar characteristics is shown in Fig. 4. This is known as the Special 5-D machine and is intended for the use of makers of small taps and twist drills up to ⅝ in. in diameter. It has very accurate adjustments on the clamps and special jaws with steel inserts to prevent wear. To use these, however, requires that the pieces to be welded must be

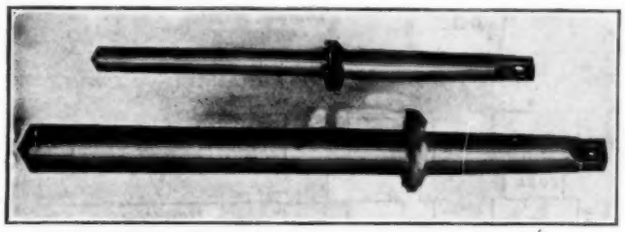


FIG. 6. TWIST-DRILL BLANKS JUST WELDED

finished to uniform size so as to accurately fit the jaws in order to conduct the current properly.

The machines shown in Figs. 1 and 3 are not only good for welding the steels mentioned, but also for Stellite work, samples of which are shown in Fig. 5, since the commonly used bits of this metal are within their range. The hand-lever toggle action is quicker and is better suited to this work than the hydraulic-pressure device used on some of the larger machines.

In welding twist drill or reamer blanks, such as shown in Fig. 6, not over ¾ in. in diameter, it has been found practical to use a pair of jaws on each side that will handle all work from the smallest up to the ¾-in. size. These jaws are made as shown in Fig. 7. The two rear, or movable, jaws on each side of the machine are flat faced, while the front, or stationary, jaws, have a V-groove cut in them just deep enough to give clearance for the smallest size of stock to be handled in contact with the face of the opposite jaw. The work is held in the jaws with a three-point contact, which has been found to be sufficient for stock of this size, although it is not to be recommended for larger work, since not enough current could be carried into the pieces without applying pressure sufficient to squeeze the work into the surface of the copper jaws. This would soon spoil all accuracy of alignment of the V-grooves.

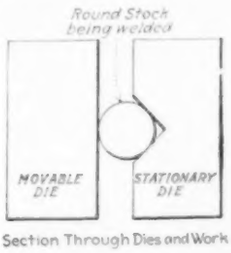


FIG. 7. COPPER JAWS FOR VARIOUS SIZES

In this connection it may be well to mention that a welding machine is not a micrometer and the welding of finished pieces is not recommended in commercial production, although such welding is done right along for special jobs. By "special jobs" is meant the putting on of an extention to a drill, tap or small reamer and the like.

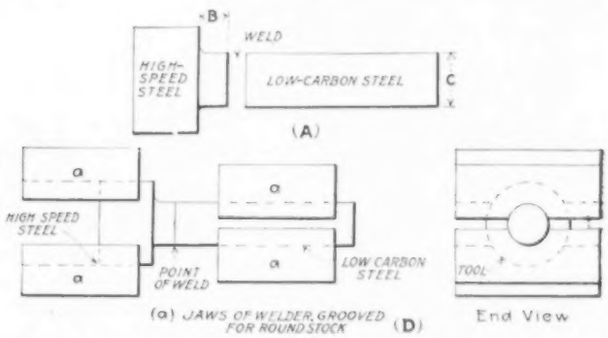


FIG. 8. COPPER JAWS FOR HOLDING LARGE HEADS AND SMALL SHANKS

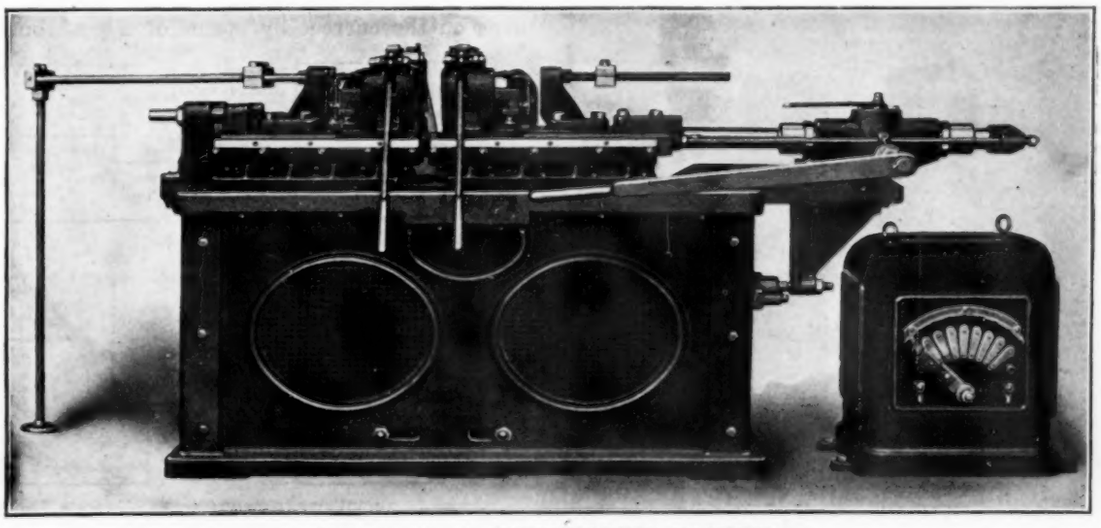


FIG. 9. No. 9 BUTT-WELDING MACHINE

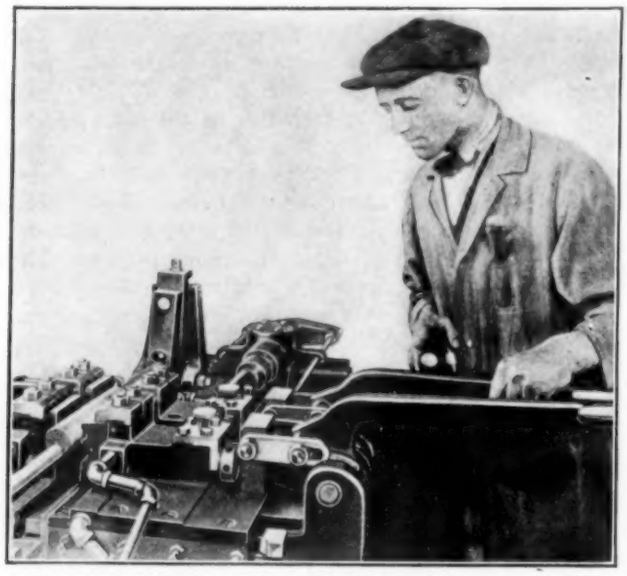


FIG. 10. CLOSEUP OF MACHINE WITH WORK IN JAWS

In welding high-speed to low-carbon steel the low-carbon steel should project approximately twice as far out from the jaws as the high-speed steel does in order to equalize as much as possible the heating of the two pieces.

Where a tool is to be made with a head larger than the shank, as shown at *A*, Fig. 8, holding copper jaws should be made as shown at *D*. In work of this kind the dimension *B* should always be about one-half of the diameter of *C*. The same rule holds good with this type of tool blank when placing it in the jaws as with steel of the same relative size; that is, the low-carbon steel should project about twice as far from the jaws as the high-speed steel since the high-speed steel has the higher resistance and has a tendency to become plastic sooner. To still further reduce its tendency to heat up quickly, the resistance should be reduced as much as possible by having the jaws as good a fit for the high-speed piece as it is possible to make them. Where different sizes are to be welded it is advisable to have special holding jaws for each separate size of high-speed steel head, although the low-carbon steel

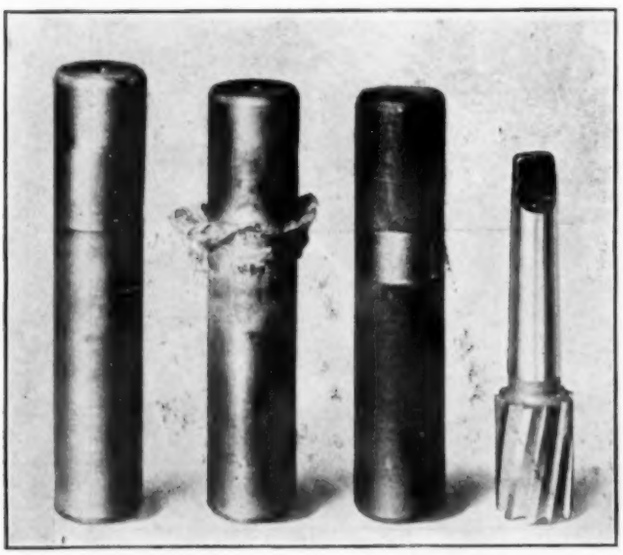


FIG. 11. STEPS IN THE MAKING OF A LARGE REAMER

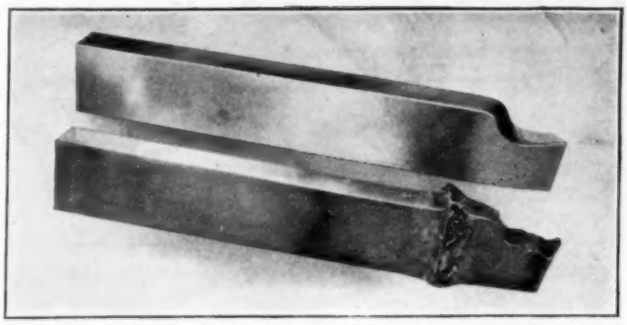


FIG. 12. A WELDED AND A FINISHED LATHE TOOL

pieces may be held in V-grooved jaws made up to hold several sizes. This is the practice of some of the largest makers of reamers and large drills.

The actual use of the machines shown for the work outlined is simplicity itself. The work is placed in the respective jaws and securely locked in place by pulling forward the two levers shown projecting upward on each machine. In addition to the grip of the jaws the work is kept from any possible slip by means of

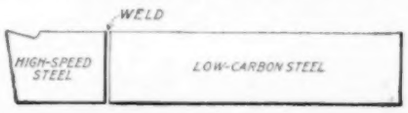


FIG. 13. HOW THE PARTS ARE ARRANGED FOR WELDING

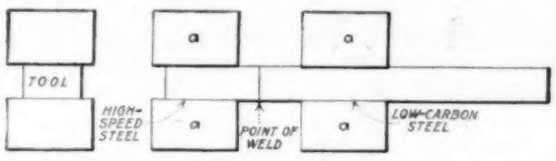


FIG. 14. HOW THE PARTS ARE CLAMPED IN THE JAWS

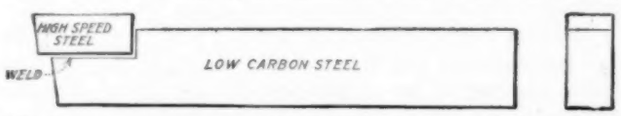


FIG. 15. METHOD OF PREPARING FOR AN INSERT WELD

stops against which the outer ends of the work are butted. With the work solidly in place the operator pulls on the pressure lever at the right of the machine until the ends of the work are in firm contact. He then turns on the current by means of a push button con-

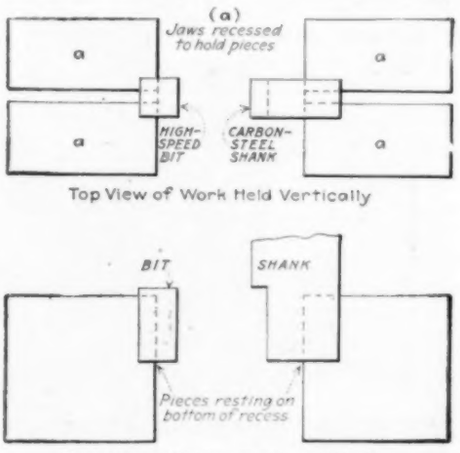


FIG. 16. JAWS USED FOR HOLDING WORK IN INSERT WELDING

veniently located in the pressure lever, and when the proper heat is reached, which is judged by the color, the push button is released. This shuts off the current and the operator then applies full pressure and the weld is made.

The maximum capacity of the largest of the three machines described is 1 in. round or its equivalent in other shapes. For larger work a machine similar to the one shown in Fig. 9 is used. This is known as a No. 9 butt-welding machine, and its capacity is from ½ to 1¼ in.; the output is from 50 to 100 welds per hour; the maximum jaw opening is 1⅞ in.; the four

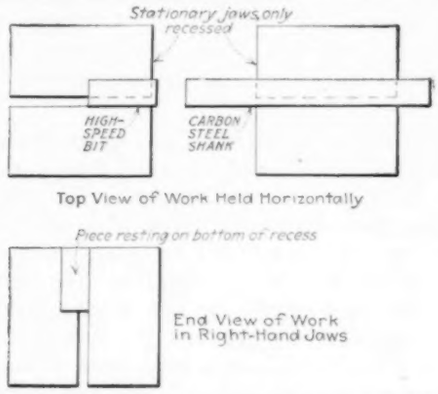

Stationary jaws only recessed
HIGH-SPEED BIT
CARBON STEEL SHANK
Top View of Work Held Horizontally
Piece resting on bottom of recess
End View of Work in Right-Hand Jaws

FIG. 17. JAWS USED FOR STELLITE BUTT WELDING

hard-drawn copper jaws are 3 in. high, 3½ in wide and 1½ in thick; the pressure device is a 5-ton hand-operated hydraulic oil jack; maximum movement with jack, 2 in.; maximum movement with one stroke of jack, ¼ in.; maximum opening between jaws, 4 in.; standard windings the same as for the previous machines; standard ratings, 40 kw. or 55 k.v.a., with 60 per cent. power

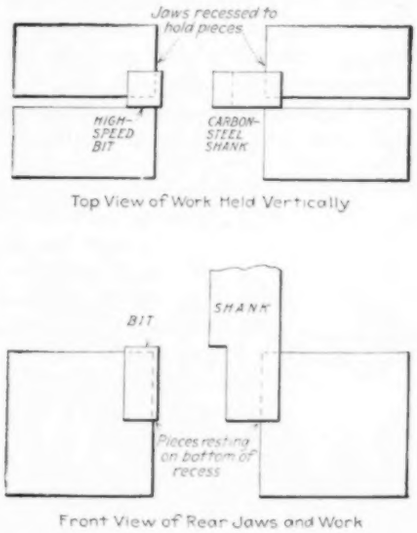


FIG. 18. JAWS USED FOR STELLITE INSERT WELDING

factor; width of machine, 27 in.; length, 60 in.; height, 46 in.; weight, 3900 pounds.

A closeup of this machine, with a large reamer blank in the jaws, is shown in Fig. 10, and progressive steps in the making of the reamer are shown in Fig. 11. The high-speed steel piece is 3 in. long by 1⅝ in. diameter, and the machine-steel piece is 6 in. long.

Two other machines (10-B and 40-A2 models) of this type suitable for heavy tool welding may be mentioned.

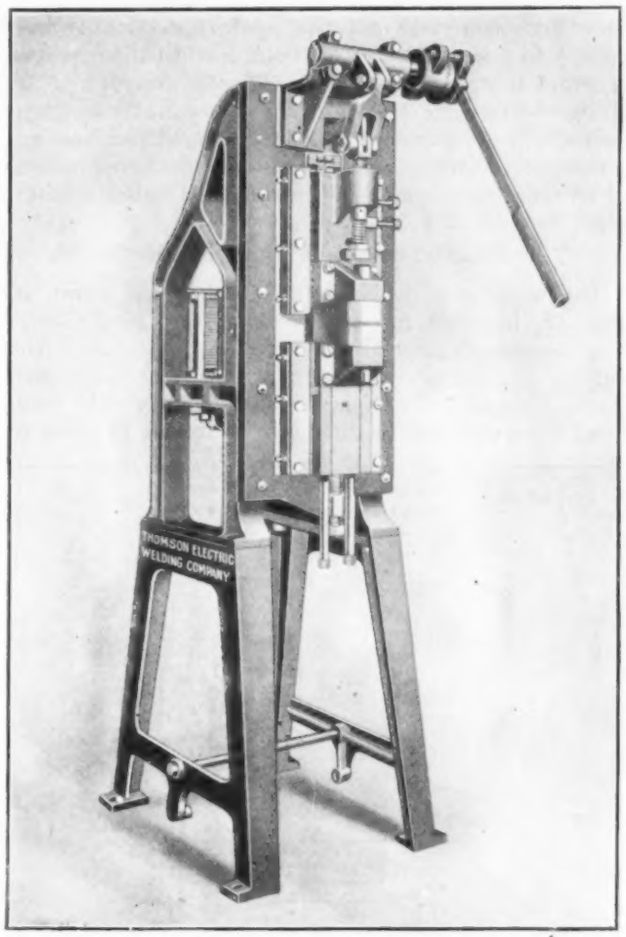


FIG. 19. VERTICAL TYPE OF WELDING MACHINE

FIG. 20. MAKING A "MASH" INSERT WELD IN A 20-AV MACHINE

They are made with a capacity of from ½ to 1½ and from 1 to 2 in. The first of these has a hand-operated pressure device capable of exerting a pressure of 12 tons and it weighs 7800 lb. The second has a pressure device which receives its initial pressure from an external accumulator, which gives an effective pressure of 23 tons; it weighs 8000 lb. and is 64 x 105 x 48 in. high.

The Welding of Other Than Round Tools

The welding of tools similar to the ones shown in Fig. 12, intended for lathe or planing-machine tools, may be done in any of the foregoing machines. The cutting parts may be of either Stellite or high-speed steel. This kind of welding is usually employed by manufacturing concerns in their own toolrooms in order to

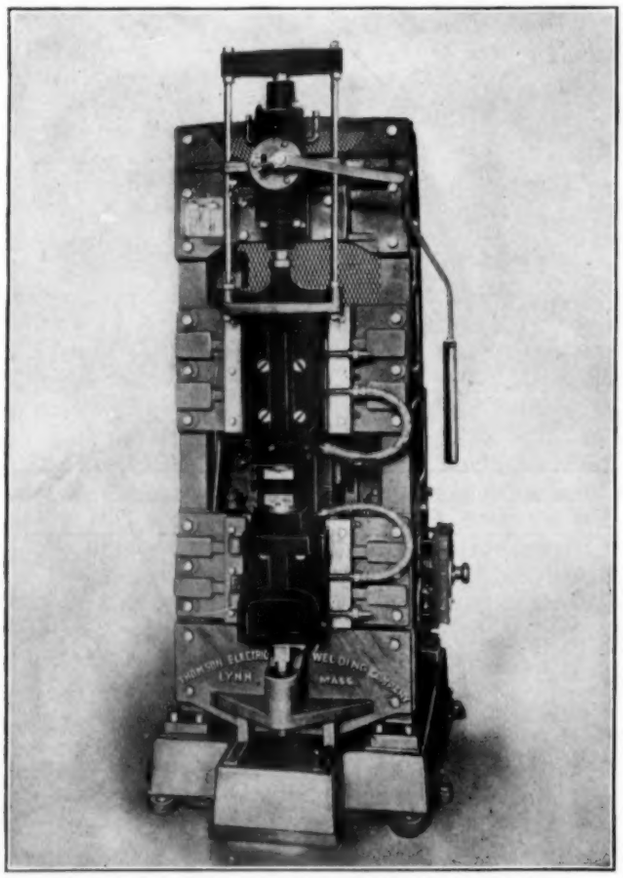


FIG. 21. LARGE 40-AV VERTICAL MACHINE

use up odd bits of high-priced steel or Stellite. The pieces are prepared about as shown in Fig. 13. Jaws for holding work of this kind are outlined in Fig. 14.

Another way to make tools for lathe or planing-machine work is outlined in Fig. 15. This method may often be employed when the one just given could not. As can be seen, in order to properly support the high-speed steel piece, the low-carbon steel shank is milled away to form a recess for the reception of the high-speed steel bit. The welding can be done on any of the machines shown provided the parts are not of too great cross-section. The method of recessing the copper clamping jaws is clearly shown in Fig. 16.

The perfect success of a welded high-speed tool depends not only on the correct welding but also upon the correct treatment after the welding itself has been accomplished. It is easily seen that if a piece of high-speed steel is welded to a piece of ordinary carbon steel and the joint allowed to cool fairly quickly in the air strains will be set up at the joint for the reason that the high-speed steel in cooling so quickly, both metals become hardened more or less but to a different degree.

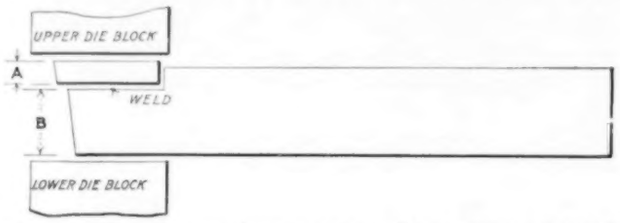


FIG. 22. JAWS AND WORK ARRANGED FOR A "MASH" WELD

Hence if the weld is subjected to any great strain under these conditions it will break either at the joint or close by, due to the strain. *It is therefore very evident that immediately after welding a piece of high-speed steel to carbon steel the work should be immediately put into some sort of furnace to be annealed.* The amount of time that the tools should be left in the furnace for thoroughly heating through and the amount of time required to allow the pieces to cool down to room temperature depend entirely upon the size and character of tool being made. However, the annealing of any piece of any size requires that the work be left in the furnace heated to at least a dull cherry red for a few hours and allowed to cool very slowly in the furnace.

If a welded tool is not properly annealed before machining much difficulty is often experienced from hard spots being encountered in the machining of the pieces, which of course is more or less disastrous to the cutting edges of the tools being used in the machining process.

The best method of hardening high-speed steel tools after the welding and machining depends also greatly upon the shape and size.

Although the welding of the various grades of Stellite is not difficult there is a certain knack in the welding

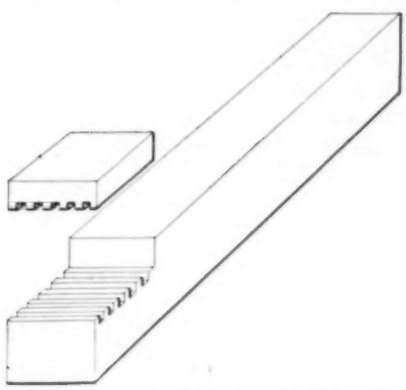


FIG. 23. PIECES GROOVED TO MAKE BETTER WELDS WITH LESS CURRENT

and also in the clamping of the stock which must be fully acquired to produce satisfactory results.

The welding should be done in a horizontal butt-welding machine with a quick-acting hand-lever pressure device. In butt welding round drill stock or rectangular tool stock the pieces should be held as shown in Fig. 17. It will be noticed that the projection of the Stellite beyond the copper jaws is very short indeed while the projec-

tion of the carbon-steel piece is comparatively long. This is because Stellite has a very high resistance compared with the carbon steel. Since in this work the heating effect varies directly with the resistance of two metals the heating in the Stellite should be retarded as much as possible by surrounding it almost completely with the copper jaws. The correct amount of projection of the carbon steel will have to be determined by experiment in each case after observing with each setting of two pieces which has the tendency to heat the fastest.

In welding in cutting bits of Stellite by the insert-weld method the pieces should be held as shown in Fig. 18.

It will be seen from this cut that the copper jaws holding the small bit nearly surround it and at the same time back up the piece to take the pressure of the squeezing up of the stock. The opposite jaws holding the carbon-steel shank do not have to grip very much of the metal but they serve to back it up to receive the force of the pressure.

In the welding itself the current is applied intermittently, as the Stellite usually has a tendency to heat very rapidly until the carbon steel is fast approaching the plastic state. The current is then held on steadily and the instant the Stellite metal "runs," the pressure lever is given a quick jerk as the current is turned off. It will be found that with a good weld there is scarcely any push up of the stock and very little of the metal flows out at the joint, requiring little grinding, if any, to finish the tool.

Unlike high-speed steel Stellite requires no further heat treatment or attention of any kind if it is welded correctly. When it is taken out of the welding machine the tool is ready for use at once after grinding off the resulting bur.

Where large numbers of tools of the lathe and planing-machine types are to be made, such as shown in Fig. 15, the highest production can be obtained by using a vertical type of welding machine built on the lines of the one shown in Fig. 19.

This machine (10-AV model) has a capacity of two pieces with contact areas between 0.40 and 0.30 sq.in. for pieces with a total thickness of $\frac{1}{2}$ to $1\frac{1}{4}$ in. The production is 35 to 85 tools per hour, depending on the size; the upper and lower jaws are of hard-drawn copper $1\frac{3}{4}$ x $2\frac{1}{4}$ in. and $1\frac{1}{4}$ in. thick; the jaw blocks are water cooled; the machine has a current variation through a five-point switch for different sizes of stock; standard windings are for alternating current 220, 440 and 550 volt, 60 cycles; standard ratings, 15 kw. or 25 k.v.a. with power factor of 60 per cent.; the pressure device is hand operated, giving a movement of $2\frac{3}{4}$ in.; maximum space between jaws, $3\frac{1}{4}$ in.; floor space occupied, 21 x 53 in.; height, 75 in.; weight, 1200 pounds.

A larger machine (20-AV model) of the same type in operation is shown in Fig. 20. This machine gives a maximum area of contact ranging from $1\frac{1}{4}$ to 1 sq.in. on pieces with a total thickness from 1 up to 2 in.; production is from 50 to 75 welds per hour; there is a throat clearance of 10 in.; the copper jaws are 2 x 3 in. and $1\frac{1}{2}$ in. thick; pressure is by hand-toggle lever and spring cushion; current control, as in the other machines, is by push button in the lever operating through a magnetic wall switch; the jaw blocks are water cooled; standard ratings are 30 kw. or 50 k.v.a. with 60 per cent. power factor; weight, 2200 pounds.

Another still larger machine (40-AV model) is shown in Fig. 21. Except for its size it is but little different from the two just described, the main difference being the hydraulic-pressure device, which gives an effective pressure of 5 tons. This machine has a maximum contact area of 3 sq.in. and will weld pieces from $1\frac{1}{2}$ to 3 in. total thickness; production, 15 to 50 welds; throat depth, $6\frac{1}{4}$ in.; jaws, 2 x 4 x $1\frac{1}{2}$ in. thick; maximum movement of upper jaw block, 2 in.; movement with one stroke of lever, $\frac{3}{8}$ in.; space possible between jaws, 3 in.; standard ratings, 60 kw. or 86 k.v.a. with 70 per cent. power factor; size, 34 x 60 in. by 79 in. high; weight, 3600 pounds.

For welding tools on these machines the relative

TABLE I. CURRENT CONSUMPTION FOR WELDING VARIOUS SIZES

Diameter of rod, inches		Dia. of rod, millimeters	Area of section, sq. in.	Current consumption per 1000 welds	Cost per 1000 welds at 1 cent per K.W.H.*	Diameter of rod, inches		Dia. of rod, millimeters	Area of section, sq. in.	Current consumption per 1000 welds	Cost per 1000 welds at 1 cent per K.W.H.*
Decimal	Fraction					Decimal	Fraction				
.25	1/4		.04909	10	$0.10	1.2598		32	1 245	270	$2 70
.2755		7	.0596	11	.11	1.3385		34	1.407	320	3 20
.3125	5/16		.0767	12	.12	1.375	1 3/8		1 4849	340	3 40
.3149		8	.0779	12	.12	1.4173		36	1 576	360	3 60
.3543		9	.0987	14	.14	1.496		38	1 757	425	4 25
.375	3/8		11045	15	.15	1.5	1 1/2		1.7671	430	4 30
.3937		10	1217	16	.16	1.5748		40	1 946	470	4 70
.4724		12	.1753	19	.19	1.625	1 5/8		2 0739	530	5.30
.5	1/2		.19635	20	.20	1.6535		42	2 146	540	5 40
.5612		14	.2472	26	.26	1.7322		44	2,356	600	6 00
.625	5/8		.3068	30	.30	1.75	1 3/4		2.4053	640	6 40
.6299		16	.3115	34	.34	1.811		46	2 576	700	7 00
.7087		18	.3946	45	.45	1.875	1 7/8		2.7612	780	7 80
.75	3/4		.44179	52	52	1.8897		48	2 802	810	8 10
.7874		20	.487	60	60	1.9685		50	3 089	870	8 70
.8661		22	.585	80	.80	2.	2		3 1416	930	9 30
.875	7/8		60132	85	.85	2.0472		52	3 286	1000	10 00
.94488		24	.701	105	1 05	2.125	2 1/8		3 5466	1100	11 00
1.	1		.7854	130	1.30	2.1259		54	3 55	1130	11 30
1.0236		26	.822	135	1 35	2.2047		56	3 82	1200	12.00
1.1023		28	.944	180	1.80	2.25	2 1/4		3.9761	1280	12 80
1.125	1 1/8		.994	190	1.90	2 2834		58	4 095	1350	13 50
1.1811		30	1 094	230	2.30	2.3622		60	4 387	1460	14 60
1.25	1 1/4		1.2272	265	2 65						

* Multiply these values by the rate you are paying per K.W Hour for current, to determine what the cost per 1000 welds for any size would be at your plant.

thickness of the two parts should be about that shown in Fig. 22. Under ordinary conditions the dimension *A* should be about one-third of *B* in order to have the point of the weld nearest the jaw in contact with the high-speed steel, so that the heating effect will be lessened and its fusion point retarded until the low-carbon steel has a chance to heat up properly.

In order to obtain the best results tools wider than 1 in. and with a recess longer than 1½ in. should be grooved as shown in Fig. 23. This reduces the section in actual contact, thereby requiring less current, is easier and quicker to heat and assures a better weld over the entire area of contact.

In order to assist those who have tool or other butt welding to do some useful data are given in Table I.

In Table II is given the proper size of copper wire to use to connect up the various machines mentioned for tool welding.

TABLE II. SIZES OF COPPER WIRE FOR CONNECTING UP DIFFERENT SIZES OF WELDING MACHINES

Type Machine	K.V.A. Demand	220-Volt Circuit		440-Volt Circuit		550-Volt Circuit	
		Size of Wire	Size of Switch and Fuses	Size of Wire	Size of Switch and Fuses	Size of Wire	Size of Switch and Fuses
10-A6 10-AV	25	No. 4 B. & S.	100 Amp.	No 10 B. & S.	50 Amp.	No. 10 B & S.	50 Amp.
No. 6	45	No. 1 B. & S.	200 Amp.	No. 6 B. & S.	100 Amp	No 6 B. & S.	100 Amp.
20-A10 20-AV	50	No. 1 B. & S.	200 Amp.	No. 6 B. & S.	100 Amp.	No. 6 B. & S.	100 Amp.
No. 9	55	No. 00 B. & S.	350 Amp.	No. 3 B. & S.	175 Amp.	No. 3 B. & S.	150 Amp.
10-B	75	No. 000 B. & S	400 Amp.	No. 2 B. & S.	175 Amp.	No. 3 B. & S.	150 Amp.
40-A2	86	No. 000 B. & S.	400 Amp.	No. 2 B. & S.	175 Amp.	No. 3 B. & S.	150 Amp.
*40-A2	107	No. 0000 B. & S.	600 Amp.	No. 0 B. & S.	250 Amp.	No. 0 B. & S.	200 Amp.

*With oil transformer

Foreman and Employment Office

BY A. SCHLEIMER

In a factory in which the control of all employees was vested in the employment office a foreman made complaint to that office that one of his men was undesirable and should be transferred or discharged. The employment manager investigated the case, satisfied himself that there was nothing radically wrong with the employee and endeavored to persuade the foreman to reconsider, but the latter was obdurate. Finally the manager said:

"I know from what you say that this man is not doing right—that he is not attending to business—but is he a good workman?"

"Yes."

"If he will overcome his faults, will you be satisfied to keep him?"

"Why, yes."

"Have you taken the matter up with him at all?"

"I have warned him repeatedly, but it does not seem to have any effect."

"All right. Now here is my proposition. If this man leaves it is a mark against your department. It is a bigger mark against me, for it not only increases our labor turnover, but brings my judgment in hiring him into question. You can see why I am as much interested in keeping him as you are, and you also know that I am interested in the efficiency of your department. Now, I will make a bargain with you. Who is the best man, in your department and the one that can be relied on most?"

"Johnson."

"Ever give you any trouble?"

"No."

"All right. Now you send Jones in to me. I will have a talk with him and send him back. You agree to keep him two weeks and promise me that no matter what he does you will treat him exactly as you do Johnson. It is understood between us alone that at the end of the two weeks I will discharge him unless you see fit to request me not to. But remember your promise to treat him just as you do Johnson."

When Jones came in the manager had a heart-to-heart talk with him. He pointed out his faults, showed him that they were due either to carelessness or thoughtlessness, and impressed on him that the foreman was very anxious to keep him in his department, but felt that as his shortcomings were due to a lack of interest in the work his stay there would soon affect the entire department.

Jones admitted that he had not been doing his best, but had an idea that the foreman disliked him personally. The manager convinced him that the foreman bore him no ill-will; that there was nothing personal in the matter at all, and obtained a promise from him to forget it and make a fresh start.

Jones went back to his department, and the foreman, true to his promise, accorded him the same treatment that he gave Johnson. The effect of this was soon apparent. Seeing that the foreman bore no grudge and had evidently forgotten the incident Jones took hold of things in a new spirit, and before the week was out there was an example of teamwork between them that never had existed before.

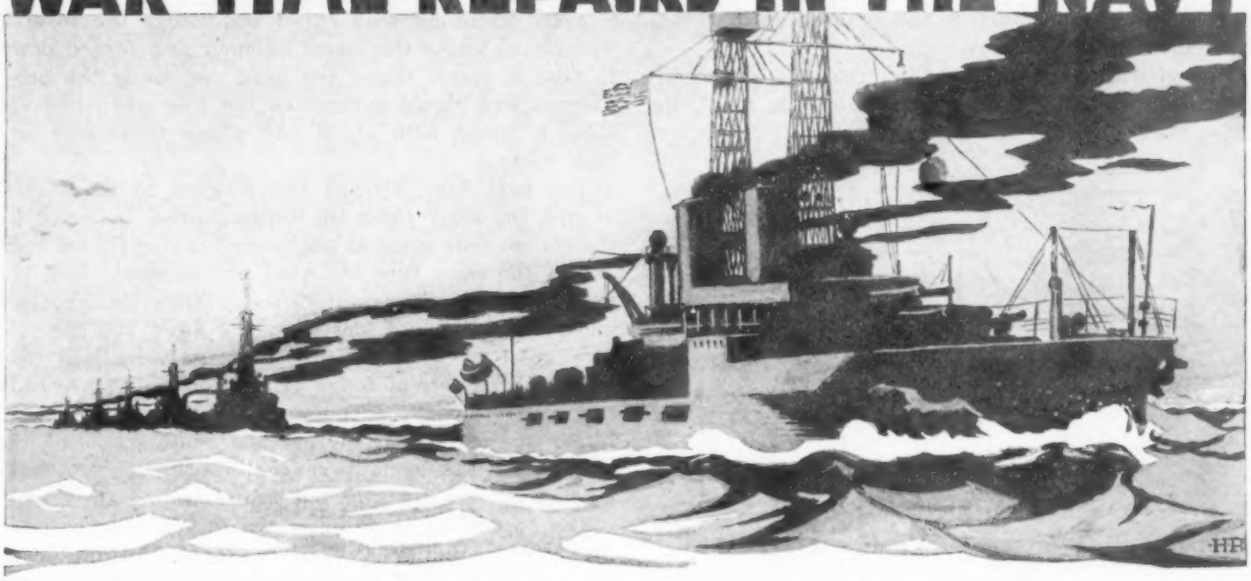
Needless to say, at the end of the two weeks the foreman reported that he would retain Jones.

"Tell me," said the foreman, "how did you do it?"

"I didn't. You did it yourself. I simply pointed the way, which you followed unconsciously. Your trouble, John, is that you are too hasty. When things go wrong it is more important to know the reason why than who did it. Don't jump to the conclusion that it is carelessness. Be reasonable. Don't argue. Argument is a fool's weapon and it does not get you anywhere."

Mix your work with a little milk of human kindness, and when you remember that the other fellow, while differently constituted from you, is just as much of a human being you will find him with you to the last ditch.

WAR-TIME REPAIRS IN THE NAVY



VI. Forging and Pattern Work

By FRANK A. STANLEY

The operations described show the method used in forging a difficult piece of work, shaping it from a round bar into a forked connecting-rod. Some examples of work done in the various shops are described and illustrated. Formulas are given for many of the alloys used by the Government.

DURING my stay aboard the United States repair ship "Vestal" I had the opportunity one morning to watch the process of forging a new connecting-rod for a 10 by 20 by 10-in. stroke, highspeed, compound dynamo engine. The work was accomplished in the "Vestal's" smith and boiler shop, which has among its important items of equipment a 300-ton steam-hydraulic forging press, a small steam hammer, an oil-fired heating furnace, plate rolls, oxyacetylene welding and cutting outfit, electric-welding machine, power saw, punch and shear, air compressor and so on.

The broken rod to be replaced is shown in Fig. 56 and its dimensions are given in Fig. 57. The forging drawing is reproduced in Fig. 58. The rod was forged to ¼ in. over these dimensions all the way around and weighed when ready for machining about 175 pounds.

The blacksmith had as a guide this drawing and the old rod which was of considerable service in aiding caliper settings for the various dimensions of the new forging. The start was made with a 14-in. length of hammered steel cut from a 10-in. bar. This was heated and worked down at one end, in the forging press, to a diameter of 3½ to 4 in. for a distance of 8 or 9 in. to form a shank for holding the work by the tongs. Then the other end was worked in the forging press to a square section about 5 in. on a side by 18 in. long. Then the remaining round portion was forged down to rectangular section, height blocks being used on the forging-press anvil to gage the thickness of the work as manipulated under the ram. After the sides had been roughly flattened, round spreading tools were used to flow and spread the metal, the action being to form a series of half-round checks across the area, after which square spreaders were used to flatten the surface so that when the ram of the forging press was brought down upon the bare metal it trued it up quickly to fairly even flat surfaces. The thickness and height were determined closely to forging limits by means of gage blocks on the press as shown at *G*, Fig. 59, and then the ends were rounded as at *H* by turning the work on the anvil and bringing the ram down to the height blocks for each position of the forging. This resulted in a series of short flats, indicated at *I*, which gave a close approximation to an arc of the proper radius.

FIG. 56. THE BROKEN CONNECTING-ROD

The neck was then outlined by forging in the half-round grooves at *J*, Fig. 60, at a distance of 5 in. from the under side of the head, and the forging was then placed on a floor anvil and two cuts made lengthwise at *K*, Fig. 61, by hand chisels and sledges to outline the material to be removed from the sides of the neck. The chisel cuts were made to a depth of 1½ in. The rough forging then appeared about as represented by the sketch, Fig. 62.

The square end of the forging was cut off to 16 in., as indicated in Fig. 61, the forging reheated and the head end and round shank cut off in the forging press, leaving the head about 6 in. long, as shown by Fig. 63. The type of chisel used under the press is shown at *L*.

The work as cut off under the machine has a roughly beveled edge all the way around, which is afterward trimmed off to a flat surface and squared up by means of a hand chisel and sledge.

Following this the neck was trimmed out to give the general outline of the taper section at this point, the

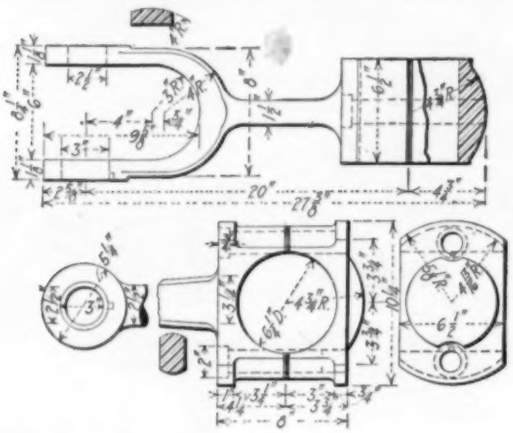


FIG. 57. CONNECTING-ROD DETAILS

dimensions of the trimmed portion being somewhat as shown at A and B in Fig. 64.

Next the forging was placed on the face of the anvil in upright position, Fig. 65, and tested with a square for general truth and squareness of outline. Then it was heated and forged down with sledges and formers in the corners *M* of the neck, then placed flat under the forging press where it was straightened under the head, a square spreading tool being placed upon the neck for this operation. Reheating the neck the forging was placed on an anvil or floor block and a half-round chisel used for trimming out all of the corners around the neck.

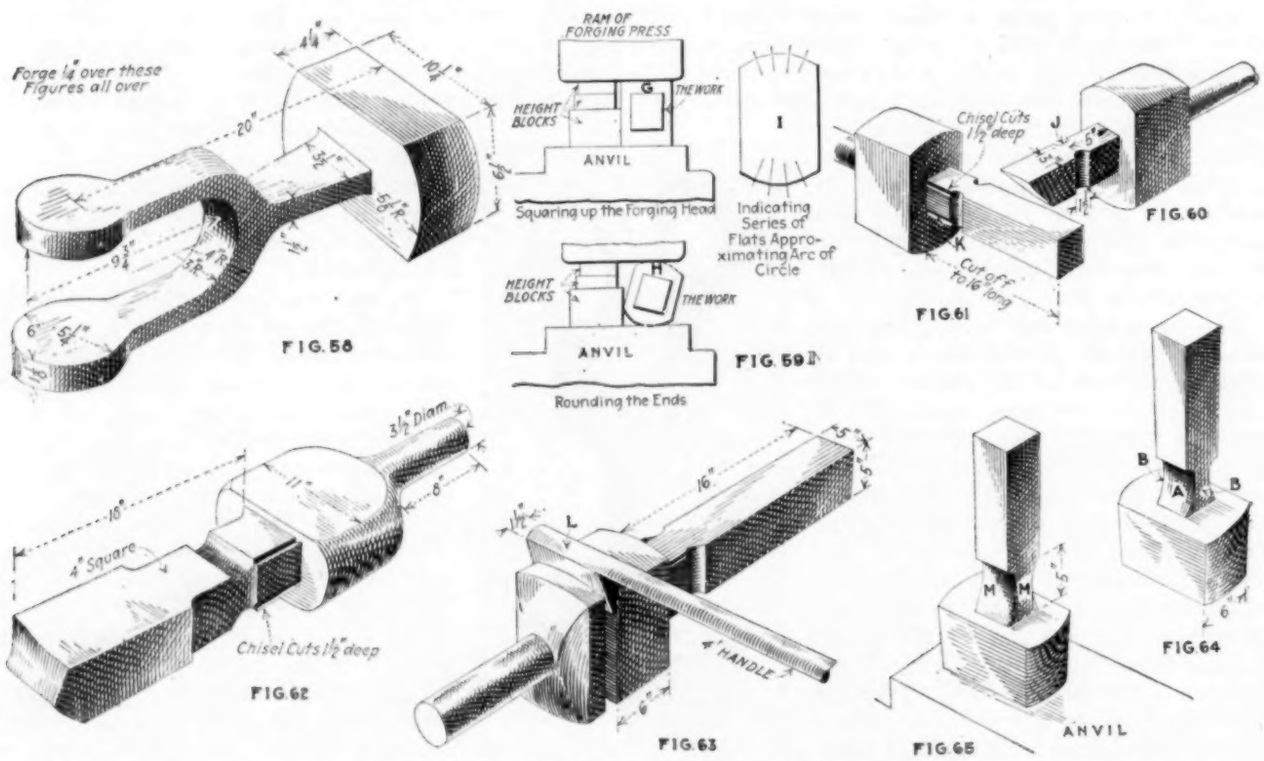
After trimming with chisel and sledge the forging was placed under the steam hammer and forged down to true it evenly under the head and along the neck. Then it was placed upright on the floor anvil and the sides trimmed with chisel and sledge to remove any high spots.

The next heat allowed the forging to be worked around the head under the forging press to round up the curved ends again to the desired radius for turning, and at the same time the head was squared along the sides to the necessary thickness. Then the shoulder under the head was placed on the anvil and the end face upset as in Fig. 66. Here the work was held upright by a pair of tongs gripped on the square body and resting upon a supporting bar underneath with a helper at each end of the bar and another holding the tongs. At the same time the head and neck were given a general dressing and truing around all corners.

The operations in forming the forked end consisted first in spreading out the body under the forging press, as in Fig. 67, and punching a hole through at the point indicated. This was to allow the forging to be split, as indicated in Fig. 68. Cuts were made from each side and most of the stock removed from the split by forcing the splitting chisel down under the forging press. This was followed by a hand-trimming process which cut out the fork openings as in Fig. 69.

The steam hammer was then used to dress the neck and body, and forge down the sides, as represented in Fig. 70, where the material worked down is indicated by the fine dotted lines along each side of the forging.

Following this the forging was placed on the anvil and the two legs of the fork bent out to about 90 deg.,

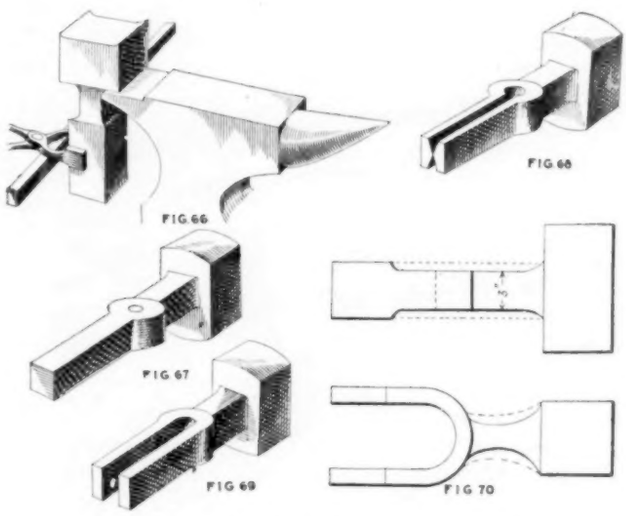


FIGS. 58 TO 65. STAGES OF THE FORGING

Fig. 58—The forging. Fig. 59—Shaping the head. Figs. 60, 61 and 62—Outlining the reach. Fig. 63—Head of forging cut off. Figs. 64 and 65—Drawing the neck

Fig. 71; then in the forging press, Fig. 72, the fork ends were flattened with a spreader to a width of 5 in. and a thickness of 1⅜ in. Next the throat was dressed out and hammered on the anvil, Fig. 73, to form the rounded interior prior to closing the fork ends; then with the fork over the anvil horn the arms or sides were hammered to parallel position. The steam hammer was then resorted to to square up the neck and forks again, after which the ends of the forks were rounded off on the anvil by sledge and chisel, as in Fig. 74. This completed the forge-shop operations and left the work ready for finishing in the machine shop.

The operations in the pattern shop and foundry on board the United States repair ship "Vestal" may be likened to those in a general jobbing plant ashore except that there is if anything a greater variety of work handled by the ship's mechanics than would be likely to come to the average establishment of the same kind "on the beach." While at first thought the "Vestal's" work has to do directly with marine repairs and ship's equipment, which might lead one to suppose that there



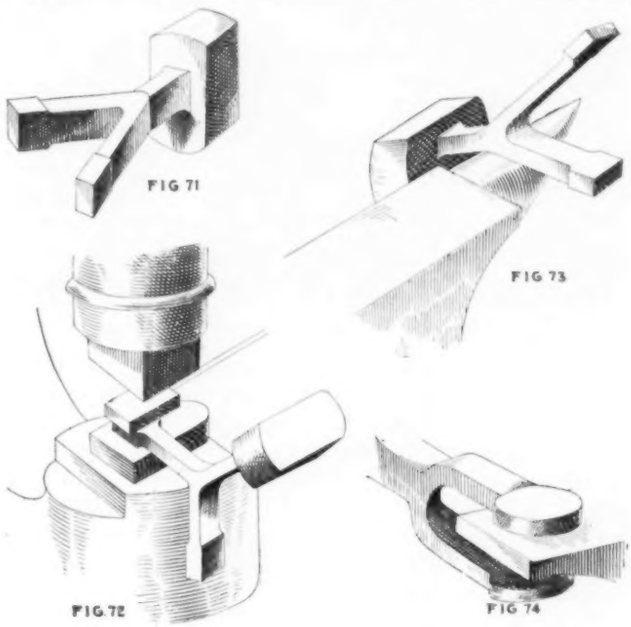
FIGS. 66 TO 70. FURTHER OPERATIONS
Fig. 66—Upsetting the end. Fig. 67—Punching to start the fork. Fig. 68—Splitting the fork. Fig. 69—Spreading the fork. Fig. 70—Drawing of forging

is a similarity about all the undertakings in the pattern shop and foundry on this vessel, a little consideration of the actual conditions in the upkeep of every department of the fleet of warships will bring one to the conclusion that a wider range of work could not be found anywhere for the attention of one establishment.

A man-of-war has in the first place the same general power-plant equipment as any first-class modern steamship and a similar outfit of auxiliary machinery in the way of steering engines, deck apparatus, pumps, dynamos, motors, etc. In addition there is much machinery peculiar to war ships, such as turret apparatus and a host of details not found on merchant vessels. Besides the navigating instruments and equipment there are a multitude of complex appliances connected with the handling of guns and the control of gun fire. The work constantly coming to the repair ships is therefore of almost endless variety, and while much of it is of a kind that is handled directly in the machine shop or optical department there is a large percentage which must be started in the pattern shop and foundry.

The pattern shop is located in a gallery at one side of the ship and is fitted up with the usual apparatus for such a department, including a speed lathe, a gap lathe, saw bench, band-saw, and jointing, trimming, boring, mortising, core-box, and saw-filing machines.

Fig. 75 shows the gap lathe with a pattern being



FIGS. 71 TO 74. SHAPING THE FORK
Fig. 71—Spreading. Fig. 72—Flattening. Fig. 73—Rounding up. Fig. 74—Finishing.

turned for a pump plunger. This is a comparatively simple piece of pattern work, finished mostly in the lathe, but a large share of the jobs coming to the pattern shop is more complicated. There are many items such as steam-chest, valve, pump cylinder and other patterns where intricate core work is necessary and where a high degree of skill is required on the part of the pattern makers. As with all special marine work, there must be no time lost in getting the patterns

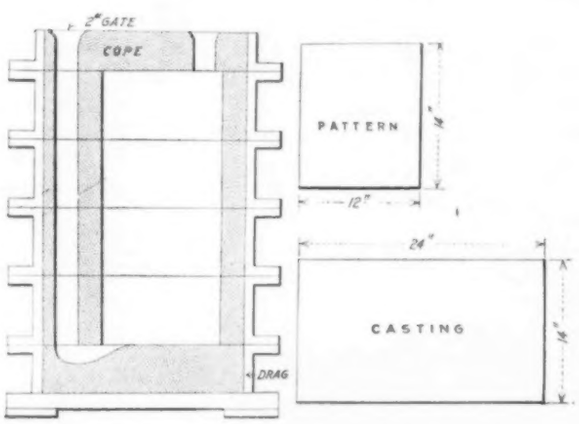


FIG. 76. SECTION OF A BUILT-UP MOLD

through making the castings and finishing the parts in the machine shop. Necessarily a great many patterns accumulate for different jobs handled by the ship, and these are all classified and stored as compactly as possible and a card index of them kept, so that they may be instantly available if wanted.

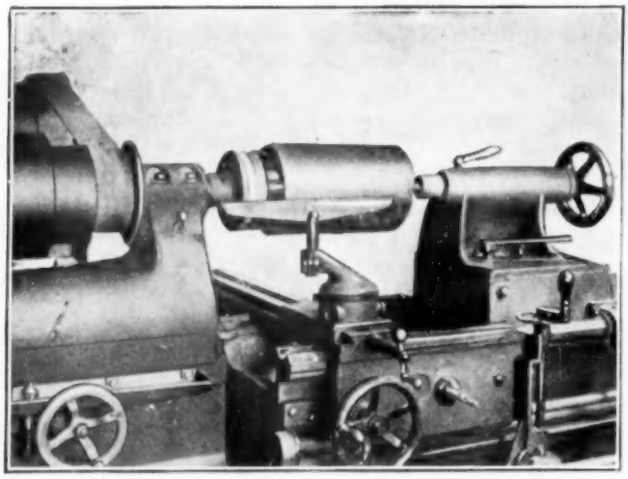


FIG. 75. A PATTERN IN THE GAP LATHE

The foundry pours castings from a few ounces in weight up to a ton or more. In one instance a bending plate has been poured weighing over 2200 lb. For a typical three-months' period last year this department poured over 40,000 lb. of metal and produced a multitude of castings of nearly every conceivable type that can enter into a ship's makeup. The equipment consists of two cupolas, several brass-melting furnaces, an overhead crane and the usual sand piles, sand pit, core ovens, pouring ladles, flasks, etc.

SPECIFICATIONS FOR VARIOUS METALS

Composition A.—Admiralty Metal (copper, 70; tin, 1; zinc, 29)—For condenser tubes, distiller tubes, feed-heater tubes, evaporator tubes.

Composition BC.—Commercial Metal (copper, 62; zinc, 30; lead, 2; tin, 6)—For name plates, cases for instruments, oil cups, distribution boxes.

Composition BE.—Brass for electrical appliances (copper, 88; tin, 2; zinc, 10)—For junction boxes, switches, distribution boxes, connection boxes, W. T. bells, buzzers, etc.

Composition Cu.P.—Phosphor Copper (copper, 90; phosphorus, 10, minimum).

Composition D.C.—Muntz Metal (copper, 60; zinc, 40).

Composition F.—Brazing Metal (copper, 85; zinc, 15)—For flanges for copper pipe and other fittings to be brazed.

Composition G.—Gun Metal (copper, 88; tin, 10; zinc, 2)—For valves, valve seats, water cylinders, buckets, stuffing boxes, glands, bearing boxes, bearings, etc.

Composition G.Ag.—German Silver (copper, 64; zinc, 20; nickel, 16)—For valves, manifolds, cocks, relief valves, hose couplings, fittings, resistances.

Composition Mo.C.—Monel Metal (copper, 23, min.; nickel, 60, min.; iron, 3.5, max.; aluminum, 0.5, max.; manganese, 3.5, max.; carbon and silicon, 0.8, max.)—For valve fittings, plumbing, propellers, pump liners, valve seats, castings requiring great strength.

Composition N.C.—Naval Brass (copper, 62; tin, 1; zinc, 37)—For hatch frames door frames, scuttle frames, fittings for tables and benches, chest fittings, stanchions, belaying pins, brass pipe flanges.

Composition P.C.—Phosphor Bronze (copper, 85.5; tin, 10.0; zinc, 4.0, max.; phosphorus, 0.5, max.)—For gears, driving nuts, bearings and castings requiring strength and bearing qualities.

Composition S.C.—Pipe-Fitting Brass (copper, 80; tin, 4; zinc, 16; lead, 3, max.)—For composition screw fittings.

Composition W.—Antifriction Metal (copper, 4.0; tin, 89.0; antimony, 7.0)—For white-metal liner bearings and for bearing surfaces.

Composition Mn.C.—Manganese Bronze (copper, 56; zinc, 37; ferromanganese, 4; Norway iron, 1.75; aluminum, 1.25)—For propeller blades, hubs, engine framing. All castings requiring great strength.

Composition XY.—Hydraulic Metal (copper, 84; tin, 11; lead, 4; zinc, 1)—For castings subject to steam, water and air pressure.

The molders on the "Vestal" find no monotony in the practice of their trade. It is one piece or a half dozen of a kind, then something else entirely different. About half of the work is run in composition or special mixtures of one kind or another, and these are all in accordance with the definite specifications of the Navy Department elsewhere in this article.

Economy in Flasks and Patterns in Foundries

The space devoted to the foundry is about 50 by 50 ft., and it is evident that no great amount of room is available for storage of flasks not actually needed, so the number is held down to what is essential. For unusual cases extra large flasks may be stowed below decks.

For molding cylindrical castings of plain form it is customary to simplify the pattern work and difficulties of storage by using one pattern for different lengths of the same diameter, the flask being set up with as many cheeks as may be required to give the necessary height.

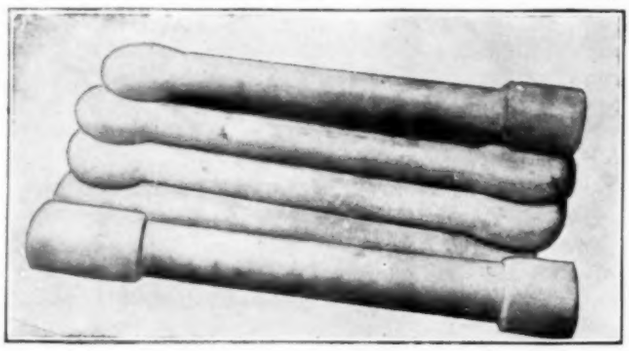
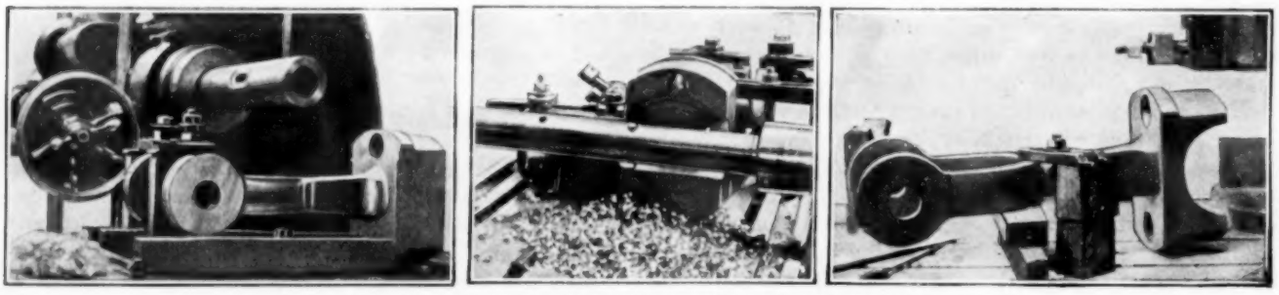


FIG. 77. SHACKLE FORGINGS

An example is given, in Fig. 76, which shows a pattern 14 in. in diameter by 12 in. long, which is used for castings up to 24 in. or more in length.

The pattern is first molded to nearly its full height as it stands on end, then it is drawn up for say 6 in., and another cheek put on, which is rammed up and followed by the lifting of the pattern again and the addition of another cheek, the different settings of the pattern being such that the top of the pattern comes above the cheek joint each time. The gate is formed in the same manner. The illustration shows the arrangement of bottom board, drag, cheeks and cope after the molding has been completed. The mold is gated at the bottom into the middle of the job to provide an easy upward slope for the metal and thus prevent washing the sand with the rush of the molten iron.



FIGS. 78 79 and 80. MACHINING THE CONNECTING-ROD

The forgings in Fig. 77 are for steel shackles, which are made up in fair-sized lots from time to time. In the size illustrated the shackles are forged to a body diameter of 2 in. and their length before bending is 22½ in. The ends are flattened and rounded to a diameter of 4 in. The stock from which the shackles are forged is 3 in. in diameter and is cut off to a length of 14 inches.

The work is bent up under the hammer before drilling. Then a hole is drilled through one side a free fit for the body of the shackle pin. The pin is 2 in. in diameter and is threaded at the end so that the hole in the opposite side of the shackle body has to be drilled and tapped to receive the thread on the pin.

A few operations in the machine shop in connection with the finishing of the connecting-rod mentioned earlier in this article are here described. The pictures show the form of the rod very clearly.

In Fig. 78 the work is seen on the table of a horizontal boring machine where the holes have been bored through the forked end for the wristpin. Before the rod was brought to this machine it was milled on the head and sides to the required width and thickness, drilled for the cap bolts and then placed on centers in the lathe and turned to diameter of head and the desired form of fork and neck.

After the fork had been bored on the horizontal machine the table was readjusted horizontally but without disturbing the setting of the work on the table. Then in the position in Fig. 79 the head of the rod was bored out in the manner represented.

The rod completed, so far as machine work is concerned, is shown in Fig. 80 undergoing the final touches with hand tools, scrapers, etc., used in removing sharp corners and burs. It is also tested while strapped in position for alignment of bearings and truth of faces.

Conservation of Material in the Shop

BY E. ANDREWS

This article by an English machine-shop foreman should be of particular interest at this time as showing the feeling toward conservation among English workmen. The illustrations he uses to explain his points sound as if they might have happened much nearer home. The material prices quoted in the table are recent enough to give an idea of relative costs here and abroad. The equivalents in our money are approximate.

THE editorial on page 543, Vol. 49, of the *American Machinist* is full of interest to me and should be to all shop managers, foremen and employees, as it is timely. You make the very forceful point that not only is it essential to prevent waste but that there is an imperative need for rigid economy in the use of "our present-day precious metals."

Experience as a foreman in a large engineering establishment for some years leads me to give a few views in regard to preventing unnecessary waste of material. I am strongly in accord with the editorial statement calling for a material-conservation department in industrial plants, and not only is this need felt in construction work of all kinds, but in the conservation of scrap-pile waste. Indeed we did not realize fully what economy meant until we were forced to it by the scarcity of material and high prices. However, it can be safely said that millions of dollars' worth of valuable castings, machine parts and tools are now being reclaimed from the scrap heap by employing modern oxyacetylene-welding methods. Probably no other equipment introduced into the mechanical industries has made possible greater economies during recent years.

I believe that if the workers only knew the value of materials much greater care would be taken in their manipulation in the shops. It may be said that it would be against the employer's interests to make generally known among the workers the price paid for material. I agree in some cases, but there are undoubtedly many instances in manufacturing operations where the lack of this information is the direct cause of unnecessary waste of material. To cite a case in point I recently found it necessary to investigate the reason for the heavy consumption of an expensive solder. This material is known as "best" or "fine" solder, and contains 67 per cent. tin and 33 per cent. lead, its present price being about £250 per ton (2240 lb.). It was found that it had been used in the manufacture of a large number of terne-coated sheet-steel tanks that were required for commercial motor vehicles instead of the much cheaper solder known as "half and half," which would have been equally suitable. It was also found that not only did the workers use this more expensive material but they used it extravagantly and to such an extent that it was possible to reduce its use by one-half and still obtain adequate strength and a neater job. Had the price of the first solder been known it probably would have been used far more reasonably.

Of late I have frequently demonstrated the high cost of material to workers in the shops and in practically every instance they were amazed at the prices. On one occasion I asked a coppersmith who was making a number of cylindrical tanks from copper sheets 0.125 in. thick (weighing 93 oz. per square foot) if he knew the value of the material. He replied he had not the slightest idea, and when I told him that the firm paid 9s. a square foot for it he was astonished. The majority of workers appear to be ignorant of the high cost of material. Why this should be so is a little difficult to understand, but at present it ought to be evident to almost anyone that material conservation is of vital importance.

Demonstrating the cost of materials to employees was put into operation a short time ago by a large manufacturing concern as part of its war-time program to give its work people some idea of the importance of eliminating waste of material in the shops. The lists were prominently displayed in the shops and the approximate price given of each class of material. It

is advisable to revise them monthly owing to the fluctuations of the market.

X Y Z WORKS, MATERIAL PRICES, DECEMBER, 1918

Coppersmith's and sheet-metal-working shops, be careful with the company's materials and you will cultivate a habit to your own benefit.

"WHO SAVES SERVES"

		s.	d.	
Aluminium, sheets	per lb.	2	6	($0.60)
Aluminium, rivets	per lb.	2	8	(.64)
Aluminium, ingots, 98 to 99 per cent	per lb.	2	0	(.48)
Brass, sheets	per lb.	1	5	(.34)
Brass, wire	per lb.	1	5	(.34)
Brass, tubes (solid drawn)	per lb.	1	6	(.36)
Brass, tubes (brazed)	per lb.	1	8	(.40)
Copper, sheets	per lb.	1	6	(.36)
Copper, bars and rods	per lb.	1	6	(.36)
Copper, rivets and wire	per lb.	1	7	(.38)
Copper, tubes (solid drawn)	per lb.	1	8	(.40)
Copper, tubes (brazed)	per lb.	1	8	(.40)
Solder, fine	per lb.	2	4	(.56)
Solder, half and half	per lb.	2	0	(.48)
Solder, coarse	per lb.	1	8	(.40)
Spelter solder (brazing)	per lb.	1	6	(.36)
Sheet steel (20 gage) black	per lb.	...	2½	(.05)
Sheet steel, galvanized	per lb.	...	3½	(.07)
Sheet steel, tinned	per lb.	...	4	(.08)
Sheet steel, terne coated	per lb.	...	3	(.06)
Tin, ingots	per lb.	2	8	(.64)
Tin plates, XXX 20 x 28 in	each	1	0	(.24)
Lead, ingots	per lb.	...	3½	(.07)
Lead, sheets	per lb.	...	4½	(.09)
Zinc, sheets	per lb.	...	10	(.20)

SCRAP MATERIAL PRICES

Every Scrap of Scrap Helps

		s.	d.	
Aluminium, 98 to 99 per cent	per lb.	1	6	($0.36)
Brass, red	per lb.	...	9	(.18)
Brass, yellow	per lb.	...	6	(.12)
Copper, heavy	per lb.	...	10	(.20)
Copper, light	per lb.	...	8½	(.17)
Lead, heavy	per lb.	...	3	(.06)
Zinc	per lb.	...	4	(.08)

MATERIAL CONSERVATION MUST BE YOUR INSISTENT AIM

The World Is Learning the Need of It

The chief reason for this particular list being selected is that the materials used in the above-mentioned shops are expensive. Consequently the prices illustrate more pointedly than those in other departments and serve to encourage the workers to save in these times when economy is so urgent. The whole question is also well worth the best thought of every manufacturer, as it affects not only his welfare but the efficiency of the nation as a whole.

Value of Women Workers in the Machine Shop

By Anne C. Halvorsen

Will the women who served in the machine shops for Uncle Sam during the war hold their places in times of peace?

It is safe to predict with reference to the plants that employed women during the war that they will continue to do so. During the readjustment period, however, there will hardly be a demand for women workers in the shop; at least not until conditions have become more settled and our soldiers have been reëmployed. The patriotic war worker is glad to step back until that time, and then she hopes and deserves to be reconsidered, and will be of course to a greater extent than before the war.

The women engaged on actual machine work have been successful. They not only made good on inspection, assembly and light bench work, but as machine operators setting up their machines and work. I have observed in my capacity as instructor for girls taking up work as machine operators that they are eager and ambitious, and if given full opportunity they become as efficient as men and often turn out a larger output.

Aside from the interest and earnestness women take in their work there is another strong factor in their success, namely, they know they are being constantly watched and sometimes criticized for minor mistakes that would have been ignored were they men. This compels them to assume a "friendly defensive attitude," so to speak, which enables them to concentrate their efforts and accomplish greater results.

It is my conviction that under well-developed management there will be increased production where women are employed on the same work as men if they are given some training before entering the shop, because the girl who shows mechanical possibilities in training will prove ambitious, steady and quick.

Inefficiency is a curse, but it can be easily remedied, as higher standards are being planned which are working out successfully. This means more production, higher wages, better living conditions and a better world.

Training School for Women

Every well-organized plant should favorably consider establishing a training school for women, and the work should be a part of the production. Under the supervision of a competent instructor, whose greatest possessions must be patience, an agreeable disposition and a mind for system, and who will prepare the student and teach her to be accurate, little work is rejected from the school; in fact the school can be made self-sustaining by the work it turns out, thus relieving the plant of any expenses in its upkeep.

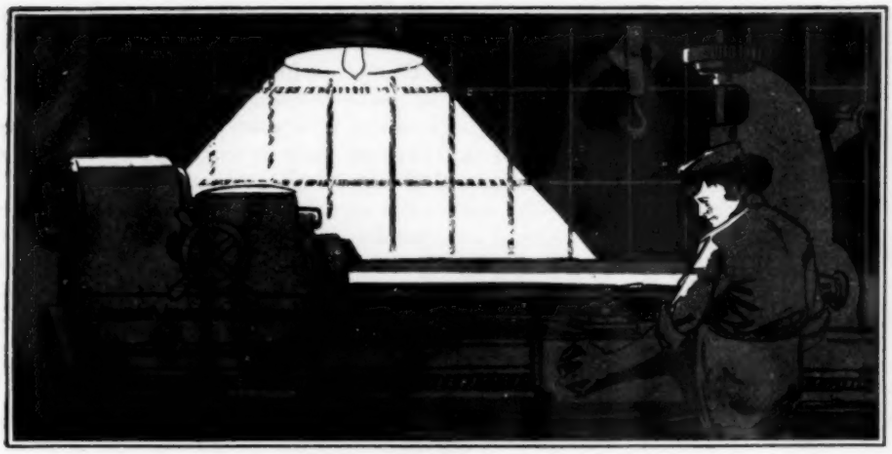
The girls in a school like to chose their own machines, and they should be given this privilege, as it means added interest. However, it may be necessary in some cases to decide for them as, for instance, when a short girl wants to operate a planing machine.

All students are enthusiastic over the school training, as it gives them confidence and a chance to prove whether they are fitted for machine work. When they learn to operate a machine they become so interested that they invariably want to learn more, such as setting up machines for turning a tapered tool or determining the different dimensions of a gear, etc.

Some men think (or is it lack of thought?) that further knowledge for women in the mechanical line other than machine operating is superfluous or beyond the scope of a woman's brains; but the woman who is really interested feels that this indifference or unawakened understanding on the part of the men is a hindrance to her progress. It is, however, gratifying to know that the majority of men understand and have expressed the value of the intelligent girl in machine production.

The greatest asset of a modern factory is a capable employment manager who understands not only shop problems and conditions, but also human nature, and the success or failure of shop conditions and production in a measure falls at his door. So also with women workers. As far as possible women should supervise women, and only intelligent girls of good character whose ages are between 21 and 35 should be considered.

Many war workers will go back to their old jobs in other factories, but those who made good at machine work and choose to remain at it should be given a place in the industrial world again.



LIGHT, ELECTRICITY and The Shop

By C. E. Clewell

Electric Drive for Punching, Shaping and Slotting Machines

This article contrasts the duty cycle of punching, shaping and slotting machines with the continuous performance of drilling and boring machines discussed in a previous article. The characteristic load requirement of the punching machine is illustrated by a graphic chart, which brings out important points in the operation of this class of machines. A brief reference is made to the underlying advantage of the individual-motor drive and illustrations of punching, shaping and slotting machines are used to bring out some of the different kinds of motors and controllers. A comparison of direct- and alternating-current motor equipment is made with notes on the use of geared as compared with belted drives.

IN A previous issue some points of importance connected with the driving problem for drilling and boring machines were discussed. The demands for power in such machines are continuous in one direction during the operation of the machine. In this

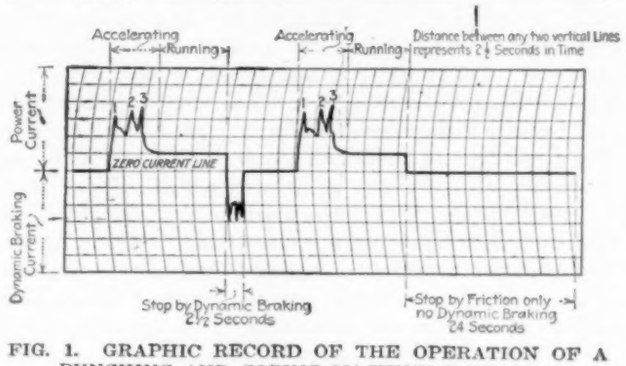


FIG. 1. GRAPHIC RECORD OF THE OPERATION OF A PUNCHING AND COPING MACHINE EQUIPPED WITH A LARGE FLYWHEEL

article the discussion is continued on a basis of punching, shaping and slotting machines in which the duty cycle throughout given operations consists of two directions of motion, and in which the limit of travel may introduce the element of time economy if the machine is brought to a quick stop by some method of braking.

Fig. 1 shows a graphic record prepared by H. F. Stratton for a punching and coping machine. This curve shows that for each duty cycle there is a short period during which the machine is brought up to speed, a period of running and a braking period. The particular machine to which this record corresponds had a heavy flywheel so that it was necessary to accelerate a load of large inertia for each new cycle. Mr. Stratton showed in an earlier issue of the *American Machinist* that this punching machine was formerly equipped with a clutch, this clutch being used to start the punch after the motor had been brought up to speed. To stop the punch due to its friction only, that is, with no braking device, required 24 seconds.

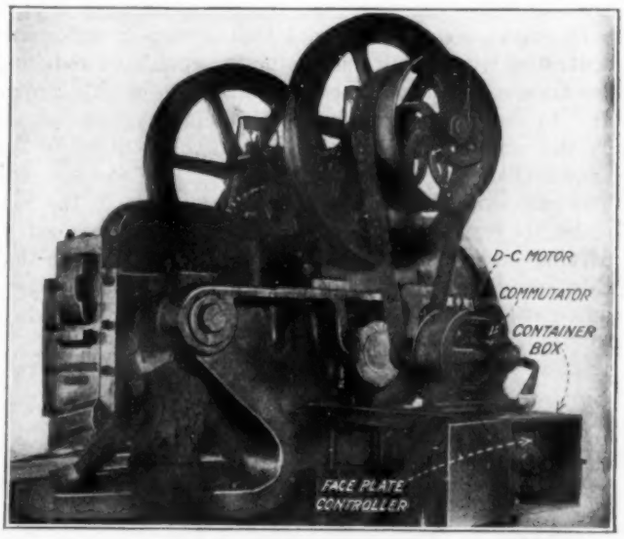


FIG. 2. PUNCHING AND SHEARING MACHINE EQUIPPED WITH A 10-HP., 850-R.P.M., DIRECT-CURRENT MOTOR

Later an automatic controller was installed which made it unnecessary for the operator to use a clutch, the process of starting requiring him merely to throw in a small lever and the motor and machine were to-

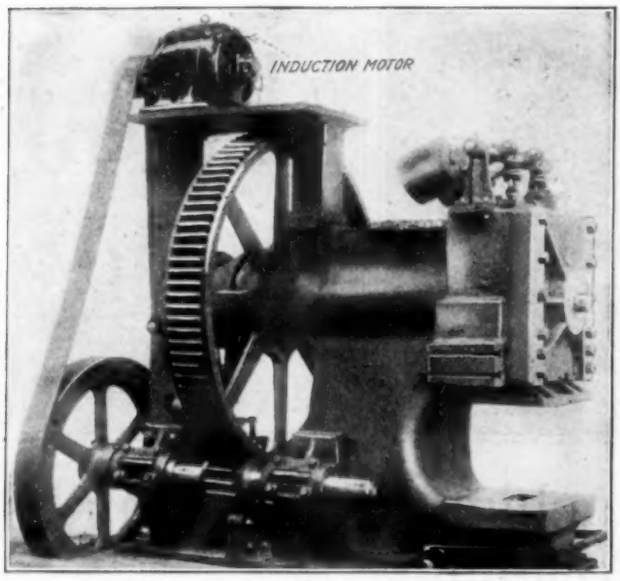


FIG. 3. PUNCHING AND TRIMMING MACHINE EQUIPPED WITH A SQUIRREL-CAGE INDUCTION MOTOR

gether brought up to normal operating speed. By this controller the machine was also stopped promptly and effectively at the end of the stroke by the dynamic braking action of the motor, this being accomplished by merely throwing the starting lever in the reverse position. Tests on machines of this class have shown that the time required to stop by this means can be reduced to about one-tenth of the time required by a friction stop.

It can be seen from Fig. 1 that a modern automatic controller with a suitable motor is capable of reducing the time required per cycle for machines of this group, and to summarize the points of advantage possessed by the motor and its automatic controller Stratton has shown that four elements stand out as follows: (a) The convenience and accuracy of starting up the machine, (b) the convenience of adjusting the speed of driving at any prescribed value and of being sure that this speed is maintained, (c) that the motor always automatically reaches this given speed after each duty

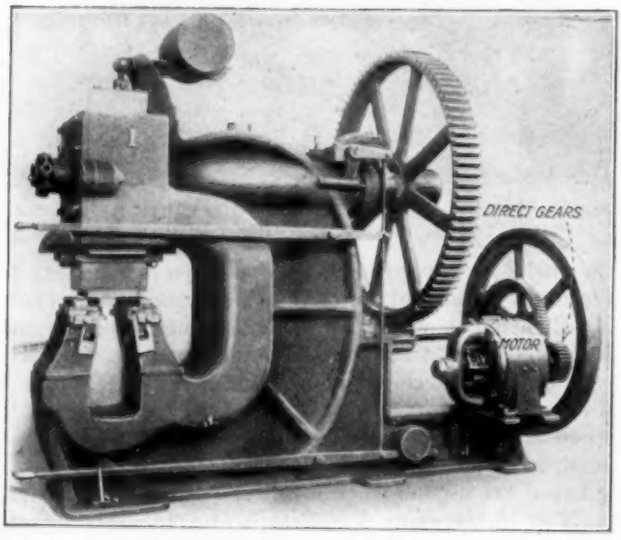


FIG. 4. PUNCHING AND SHEARING MACHINE WITH MOTOR DIRECTLY GEARED

cycle when the new cycle is under way without any attention on the part of the operator, and (d) that when the control element is placed in a position to stop the machine by dynamic braking, the motor as well as the machine is brought to a dead stop, thus removing the need of clutches and countershafts and avoiding the disadvantage of the driving mechanism running idle when the machine is at rest.

It should be remembered in the foregoing explanation of Fig. 1 that the advantages mentioned do not necessarily accompany motor drive unless the control equipment for the motor is properly selected, this pointing to the importance of the controller as well as the motor.

In shops with direct current only, the types of motors

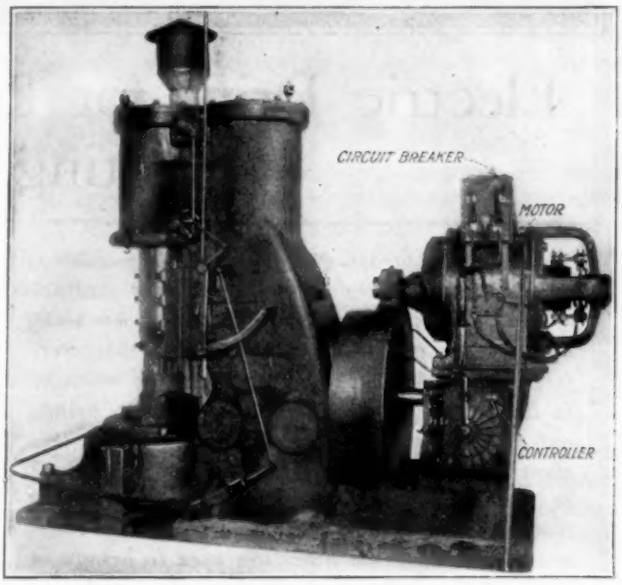


FIG. 5. AIR FORGE HAMMER WITH A 25-HP., 750-R.P.M. MOTOR GEARED TO THE MACHINE. THE BED OF THE MACHINE IS DESIGNED TO ACCOMMODATE THE MOTOR

for machines of this class are the adjustable-speed shunt-wound for use where wide limits of driving speed are required, and the constant-speed shunt or compound wound for use where only one speed is required or where various speeds are obtained through the use of speed boxes or the ordinary cone-pulley arrangement.

Where alternating current is used the induction motor may be employed. In this type, the so-called squirrel-cage motor corresponds in its speed characteristics very closely to that of the constant-speed direct-current motor and must be used with a speed box or cone pulleys and belts if a number of different speeds are required. The other type of induction motor is that of the wound secondary class for use with loads which call for large starting torque. Where the machine has a large inertia effect, as with punching machines, large starting torque is sometimes provided in squirrel-cage motors by making the resistance of the rotating member higher than ordinary; that is, in arranging it to operate with a larger drop in speed between no-load and full-load conditions than is usually the case. This is known as a squirrel-cage motor with large slip.

In the previous article on drilling and boring machines a simple formula was given for the horsepower rating of the motor required to operate a drill on a basis of the number of cubic feet of metal removed

per minute and certain empirical constants for the approximate horsepower per cubic foot of metal removed per minute. In machines of this class, however, with operating cycles like that shown in Fig. 1, the determination of horsepower is not subject to quite such a simple relation because of the changing current requirements throughout each cycle. A number of ways have been developed for the determination of horsepower corresponding to a varying load of this kind, but it is not the purpose to discuss that phase of the problem in this article other than to call attention to the tables of horsepower ratings recommended by the Westinghouse Electric and Manufacturing Co. for machines of this group of different sizes.

To illustrate the scope of these tables several are given for both punching and shearing machines. For

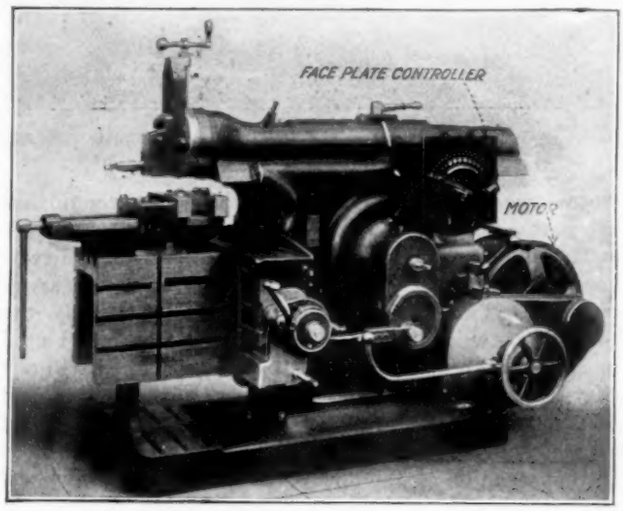


FIG. 6. A 25-IN. SHAPING MACHINE DRIVEN BY A 3-TO-1 ADJUSTABLE-SPEED, DIRECT-CURRENT MOTOR WITH FACEPLATE CONTROLLER

small machines used to notch sheet iron any one of the three standard types of motors may be used in sizes ranging from one-half to several horsepower. For the machines listed in the tables, however, the direct-current motor should be of the compound-wound type in the constant-speed class, and if an induction motor is employed it should be either of the wound-secondary type or a squirrel-cage type with large slip (approximately 10 per cent.) in the larger sizes, as explained above.

TABLE I. APPROXIMATE HORSEPOWER RATING RECOMMENDED FOR PUNCHING MACHINES

Diameter in Inches	Thickness in Inches	Hp.
½	¼	1
⅝	¼	2 to 3
¾	¼	2 to 3
⅞	¼	3 to 5
1	¼	5
1	½	5
1	¾	7½
1¼	1	7½ to 10
1½	1	10 to 15
2	1	10 to 15
2½	1½	15 to 25

To illustrate the points in the use of motors for punching machines, reference will be made to a number of photographic reproductions. In Fig. 2 a punching and shearing machine is shown with a direct-current motor belted to the pulley. The controller employed is an ordinary faceplate hand-operated rheostat.

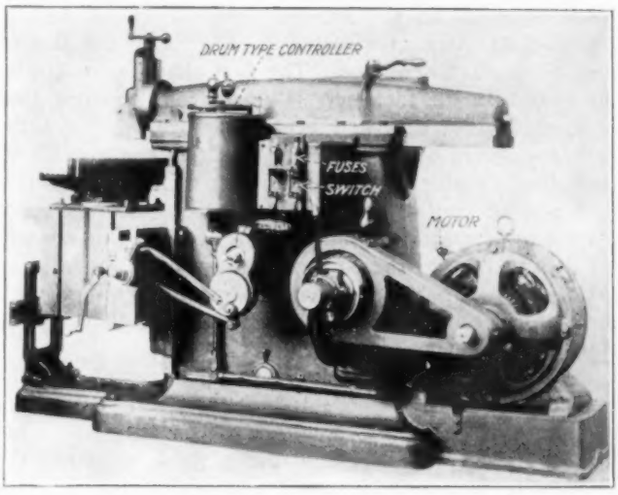


FIG. 7. A 28-IN. SHAPING MACHINE DRIVEN BY A 4-TO-1 ADJUSTABLE-SPEED, DIRECT-CURRENT MOTOR WITH DRUM-TYPE CONTROLLER

A good deal of attention has been given to the relative merits of motors with belt connection and with gear connection to the machine, an example of the former being shown in Fig. 2 and of the latter in Fig. 4. A representative machine-tool manufacturer, in commenting on this point, states that all later designs

TABLE II. APPROXIMATE HORSEPOWER RATING FOR SHEARING MACHINES

	Horsepower	
Width in In.	Cut ¼-In. Iron	Cut ½-In. Iron
30 to 42	3	5
50 to 60	4	7½
72 to 96	5	10
Bolt shears		7½ hp.
Double-angle shears		10 hp.

of his machines are arranged for belt-connected motor drive in preference to the gear-connected motor equipment, the reasons given being as follows: With belt drive the efficiency with a properly designed driving equipment is as great as with gear connection; the belt drive is classed as safer, and among the advantages given are quietness and smoothness of operation and low maintenance of the belt compared with the gear-driven machine. This opinion is given for what it is worth

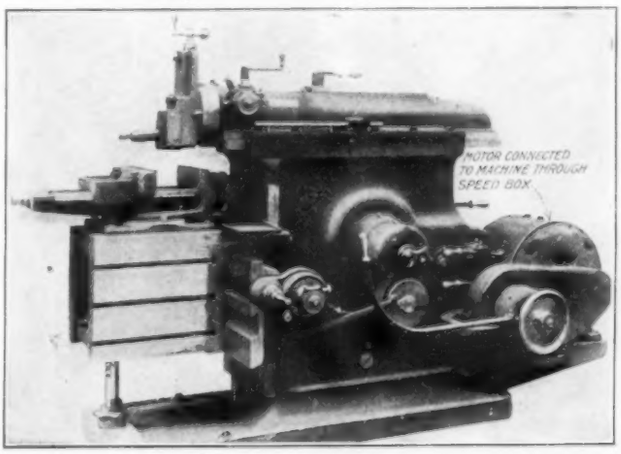


FIG. 8. A 24-IN. HEAVY-SERVICE SHAPING MACHINE ARRANGED TO BE DRIVEN EITHER BY A CONSTANT-SPEED OR AN ADJUSTABLE-SPEED MOTOR THROUGH A GEARED SPEED BOX

as a comment on the general arrangement of Fig. 2. Special attention is directed in Fig. 2 to the use of the direct-current motor. The fact that the controller is placed in an inclosure is partly an evidence that a good deal of dirt and grease is thrown off by the belt and gears of the machine tool. It can readily be seen that a motor with a commutator as in Fig. 2, which has sliding contacts where the carbon brushes press on the commutator, would be subject to a certain amount of falling dirt in the form of grease particles or even grit, which is likely to act as a disadvantage in the operation of the motor, as such deposits gather on the face of the commutator.

From this standpoint there is an advantage in the use of the squirrel-cage induction motor without a commutator as in Fig. 3, although the comparison between Fig. 3 and Fig. 2 is not a good one since the motor in Fig. 3 is mounted well above the machine and would quite naturally be less subject to scattered dirt than a motor placed as in Fig. 2. The belt connection in Fig. 3 is to be noted, and also the very heavy inertia of the moving parts of this machine, making a fairly large starting torque essential in the motor if the machine is to be accelerated up to its normal speed from rest promptly. As indicated in connection with the horsepower tables this feature is accomplished in the squirrel-cage induction motor (the type shown in Fig. 3) by the use of rather high permanent resistance in the rotating element of the motor, which gives it somewhat worse speed regulation but accomplishes the necessary torque requirement at starting.

TABLE III. APPROXIMATE HORSEPOWER RATING FOR LEVER-SHEARING MACHINES

Size in In.	Hp.
1 x 1	5
1¼ x 1¼	7½
2 x 2	10
6 x 1	
2½ x 2½	15
1 x 7	
2½ x 2½	20
1½ x 8	
3½ x 3½	30
4½ round	

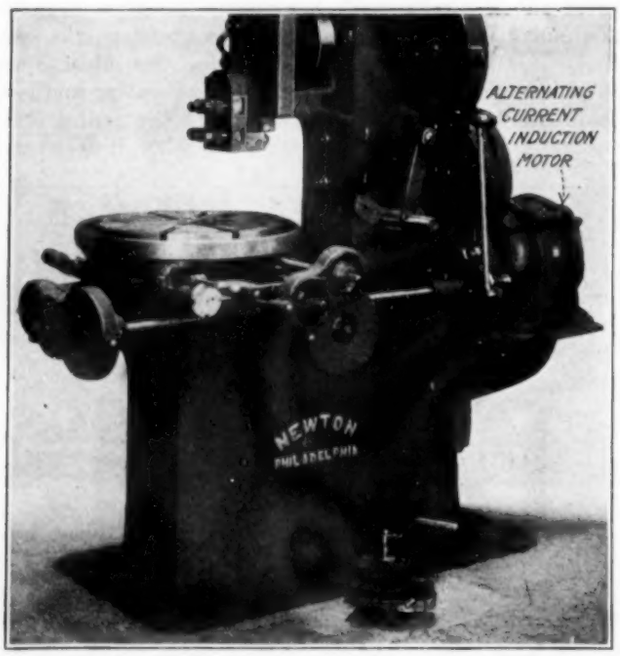


FIG. 10. SLOTTING MACHINE DRIVEN BY AN INDUCTION MOTOR THROUGH FULLY INCLOSED GEARS WITH A LEVER FOR CONTROLLING SPEED

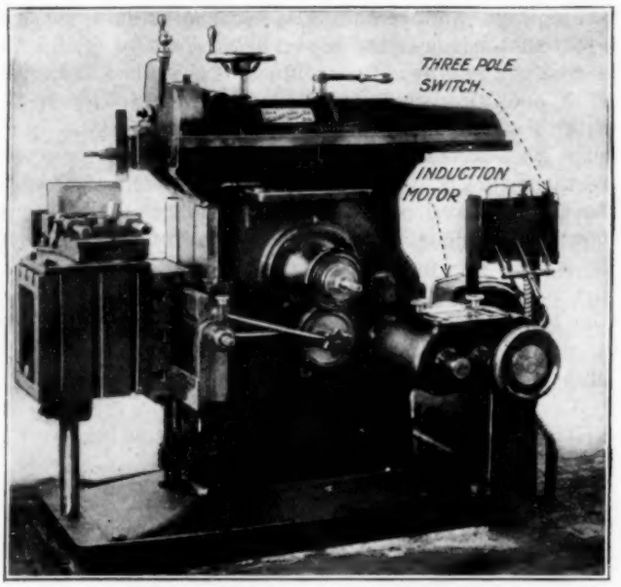


FIG. 9. A 15-IN. SHAPING MACHINE OPERATED BY AN ALTERNATING-CURRENT INDUCTION MOTOR

Turning to Fig. 4 we have a good example of a direct-gear-connected motor-driven punching and shearing machine. This case is included to show clearly the contrast between the geared arrangement and the belted machines of Figs. 2 and 3. It will be noted in Fig. 4 that the motor is mounted on a special bracket attached to the bed of the machine, thus making the motor and the machine a unit. The flywheel effect is indicated in this machine by the large gearwheel and the flywheel to the right.

A somewhat different machine is that in Fig. 5, which shows an air forge hammer with a 25-hp. motor mounted on a special support to the right. This motor is operated at 750 r.p.m. and is geared to the machine through a protected gear. The control equipment consists of an open-dial type hand-operated rheostat attached directly to the support for the motor with protecting circuit-breakers on a small panel mounted on the motor frame. It will be seen from the illustration that the bed of the machine has been designed expressly for suitable attachment of the motor.

Motor Drive for Shaping Machines Presents Some Problems

The shaping machine presents some problems in the type of motor to employ and the methods of mounting it and the controller on the machine. Fig. 6 illustrates a use of the direct-current adjustable-speed motor in conjunction with a regular faceplate hand-operated controller. The motor in this case has a range of speed of 3 to 1. Geared connection is employed and the rheostat or controller is attached to the side of the machine within convenient reach of the operator. It is perhaps apparent that an automatic controller could be placed in the same position as the manually operated rheostat shown in this illustration, thus removing from the operator the necessity of starting the motor by a hand-graduated controller and giving to the equipment the advantages that were described in connection with the graphic record shown in Fig. 1.

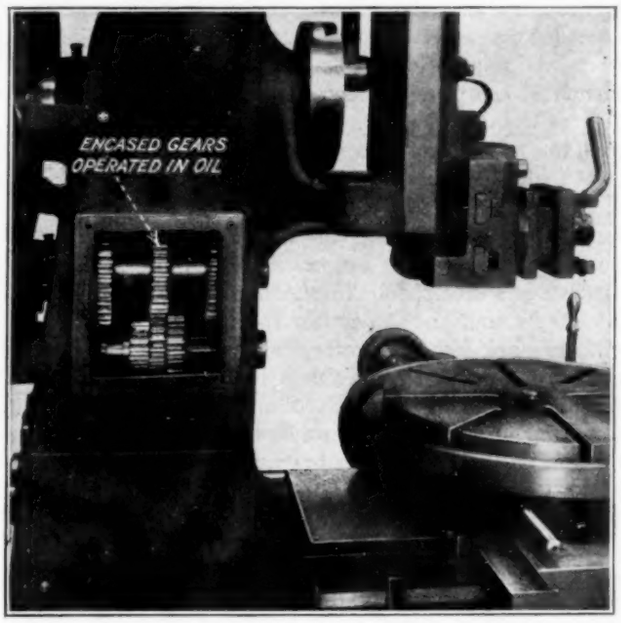


FIG. 11. SLOTTING MACHINE WITH COVER PLATE REMOVED SHOWING THE GEARS FULLY INCASED SO AS TO OPERATE IN OIL

In order to contrast the method of control shown in Fig. 6 with the method employing a drum type of controller, which has become so widely used in machine-shop practice, Fig. 7 is shown. Here an adjustable-speed direct-current motor having a speed range of 4 to 1 is employed along with a drum-type controller, shown to the left of the illustration. Immediately to the right of the controller a small panel is mounted on the side of the machine, with a switch and fuses for a protection to the motor circuit. It may readily be seen by comparing Figs. 7 and 6 that the drum type of controller lends itself exceptionally well to shop work. The contacts are inclosed in the case and the handle is not only a convenience to the operator but is here placed so that it may be reached without leaving the normal position of operation.

Both the examples of Figs. 6 and 7 have shown applications of the direct-current motor with wide ranges in speed. There is no reason, however, why a constant-speed motor may not be employed provided due regard is given to the requirements of speed changes. In Fig. 8 a 24-in. heavy-service shaping machine is shown with the motor arranged to supply power through a speed box so that a constant-speed motor may be employed; although an adjustable speed unit may also be used, in such a case giving just that much more flexibility in the control of speed. The compact appearance of each of the shaping machines in Figs. 6, 7 and 8, is apparent since the motor has been adapted to the machine in a way to produce a good mechanical as well as electrical result.

To illustrate the use of an alternating-current induction motor for shaping-machine operation Fig. 9 shows a 15-in. machine driven by an induction motor mounted in the rear of the machine. The three-pole switch for the motor is indicated clearly to the right immediately above the motor with the electric wires of the power supply passing directly from the switch through a flexible conduit to the iron conduit in the floor.

In Fig. 10 a slotting machine is shown equipped with an induction motor mounted on a special bracket to the right. In this case the power is transmitted to the machine through completely inclosed gears (not shown in Fig. 10), and a lever is employed for securing speed changes. The gears as used here are so incased that they may be operated in oil, and this general arrangement is classed by the machine manufacturer as an excellent method of applying power to such machinery. In Fig. 11 the cover plate is removed so as to show the gears in their inclosing case. It is possible to use the reversing motor, as with the modern method of planing-machine driving, instead of the ordinary induction motor in Figs. 10 and 11, this latter scheme being a good one because of the reduced amount of gearing required.

Finally in Fig. 12 a slotting machine is shown with an individual motor attached to the side of the machine frame and the outer gearing being exposed to view. In all of these illustrations the adaptability of the motor to almost any position of mounting and for practically any condition of service will be apparent.

A good deal might be said regarding the economy and advantages of the individual motor for machinery of this class in contrast to the group method of driving. In conclusion there seems no better way of summarizing the foregoing remarks than to include a brief statement made some time ago by E. P. Bullard and quoted effectively by Mr. Stratton in his article in the *American Machinist* previously referred to, in which he says in part:

"In analyzing the various elements of machine tools the question naturally arises, Wherein can they be improved? There are many ways. First, let us consider the question of control. Control is the essence of machine-tool operation. It plays the largest part in the production of work. Control is everything. We

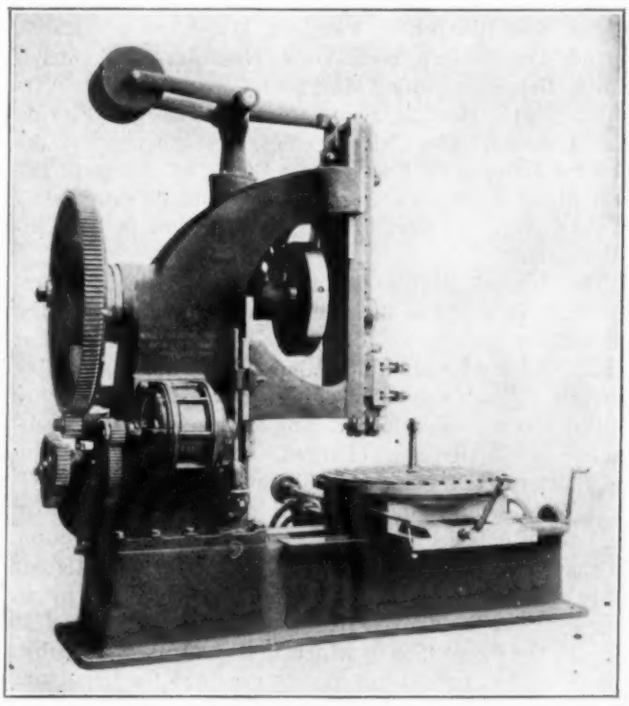


FIG. 12. A MOTOR-DRIVEN SLOTTING MACHINE WHERE THE MOTOR IS ATTACHED TO THE SIDE

see it in other products and think nothing about it. When you touch a typewriter key and the letter is impressed on the paper we think little of that; but there is infinite exactitude in getting that impression.

"And so with the machine tool. It must not merely be started and stopped; it should be started precisely at the right time, under perfect control, and should be stopped exactly when you want it. The machine tool should do the work; the operator should use his energy solely in directing it. He should not be called upon to spend his valuable time or his mental energy in operating an oil can on 60 or 100 different holes which are supposed to be oiled. He should not be called upon to shift dangerous belts or move heavy parts. We can do all of these things by power."

Operations of the United States Employment Service

For the first time in the history of America's development employers have the opportunity of selecting from a large and varied list of highly educated and experienced men individuals especially equipped to meet their particular requirements.

Engineers, executives and men of college training and practical experience in the business and technical fields are returning from Army, Navy and war work. The Professional and Special Section of the United States Employment Service, a branch of the Department of Labor, has been organized for the benefit of employers in need of these men, and its service is entirely free of charge. The organization already has thousands of well-educated skilled men on its lists and is daily putting many of them in touch with employers.

The country is divided into two great zones for the purposes of the Professional and Special Section. The New York Office, headquarters for the Eastern Zone, at 16 East 42nd St., is in charge of the following states: Maine, New Hampshire, Vermont, Massachusetts, Rhode Island, Connecticut, New York, New Jersey, Pennsylvania, Delaware, Ohio, Maryland, Virginia, West Virginia, North Carolina, South Carolina, Georgia, Florida and Alabama. The Chicago office, headquarters for the Central Zone, at 63 East Adams St., is in charge of the remaining states. Later zone offices will be established to take charge of part of the territory now in the Chicago zone.

The United States Employment Service is represented in each of the 48 states by a head office under the immediate jurisdiction of the federal director of that state. All local community labor boards are responsible directly to the federal director in their work of placing skilled and unskilled labor. The office of the federal director is particularly charged, however, with filling requisitions from employers for the highest type of business, professional and technical men. These men are registered only in the Professional and Special Section. In case the office of the federal director for a particular state cannot supply the high-grade man required by an employer the requisition for that man is forwarded at once to the zone office to which that state is responsible. Likewise the applications of men qualified for important positions are forwarded through the same channels.

The zone offices at New York and Chicago have therefore become clearing houses where returning men are classified in accordance with their qualifications and where the requisitions of employers are matched against them. So complete is the system of classification and so diverse the qualifications of the thousands of applicants that the most exacting requirements of an employer as stated in his requisition can be met in each detail.

The United Engineering Societies, composed of the four great engineering organizations—the American Society of Mechanical Engineers, the American Society of Civil Engineers, the American Institute of Electrical Engineers and the American Institute of Mining Engineers—are now coöperating with the Professional and Special Section in placing men in the engineering professions. The high standard maintained both by the Government organization and by the societies has proved to be of the utmost benefit to employers as well as to experienced engineers seeking employment.

A branch has been organized for the registration and placement of teachers. At present this branch is operating in the head office of each state under the management of the federal directors, and whenever necessary both positions and applications are cleared to the zone office.

The interests of women fit for high-grade business and technical and professional positions are cared for by another branch, which is administered by experienced professional women. In order to register in the women's branch an applicant must be either a college graduate or experienced in some particular line of executive or administrative work.

The type of men and women registered is indicated by the following partial list: Statistical workers, stenographers, typists, clerks, accountants, advertising and publicity workers, agricultural experts, artists, auditors, bacteriologists, bankers and brokers, biologists, chemists, chemical engineers, cost experts, credit managers, dentists, draftsmen, editors and journalists, electrical engineers, executives, general managers, household-economy experts, industrial engineers, lawyers, librarians, mechanical engineers, metallurgists, mining engineers, nurses, office managers, pharmacists, physicians and surgeons, production managers, purchasing agents, real-estate and insurance workers, refrigerating engineers, safety engineers, sales managers and salesmen, secretaries and correspondents, social, civil and religious workers, superintendents, surveyors, teachers, traffic managers, works managers and inexperienced college graduates.

The employer should get in touch with the office of the federal director in his state or write direct to either the New York or Chicago zone offices. It is important that complete and specific details be given of the position to be filled, together with the maximum and minimum salary he will pay. These details are regarded as confidential by the Government and are withheld from the applicant.

Once introduced to each other the employer and applicant are left to work out details. Often a number of applicants with equally good qualifications are referred to the same employer in order that he may decide for himself on the basis of their personalities.

The New York and Chicago zone offices are now placing men at salaries ranging from $1000 to $15,000.

Disability Under the Compensation Acts—I

By CHESLA C. SHERLOCK

Do you know what constitutes "disability" or "incapacity for work" under the Workmen's Compensation Acts? Or how long a workman should be paid for temporary disability? The statutes of the various states differ somewhat on these points, of course, but the general principles are the same. The discussion of temporary disability in this article throws a good deal of light on the probable interpretations of the courts which, after all is said, have the greatest interest for employer and workman. Coming articles deal with other forms of disability.

ACCORDING to the workmen's compensation acts the employer is bound to pay compensation to workmen for "disability" or "incapacity for work," provided such disability or incapacity is the result of an accidental injury arising out of and in the course of the employment.

The statutes very generally recognize that there are several degrees of disability and proceed to define them, outlining in each case the measure of the compensation which the employer shall pay in case the workman sustains such disability.

As to what constitutes compensable disability and as to what injuries are to fall within the limited classes mentioned by the statutes there is considerable dispute. Only by an examination of the cases decided by the courts bearing on this point can we find any light as to just what is meant by the legislative phrases mentioned above.

Disability is generally divided into: (1) Temporary, (2) partial and (3) permanent. The best general definition of these classes that can be given is to say that each class means just what the words given above signify. There is no difficulty in saying that a temporary disability is one which is merely for the time being; but to attempt to classify a given injury such as may arise in practical experience is an entirely different matter.

The reason for this is that two workmen may sustain an identical injury, but it will affect them differently. One man may be suffering only from a temporary disability and have his full earning power restored within the course of a few weeks, while the other, by nature of his previous condition of health, may have his suffering prolonged indefinitely and may never recover the earning power he enjoyed prior to his injury.

The final analysis rests of course with the courts, but it is really becoming the practice to rest the matter largely with the opinion of competent medical men. In a given case where it is doubtful whether the injury is temporary or permanent, and it is desired to adjudicate the workman's compensation rights, the final decision will rest largely on the opinion of medical experts familiar with the injury in question.

The statutes have said in most instances just what the measure of compensation shall be for a temporary disability, and these statutory allowances are based on what is assumed to be a reasonable time for all injuries of such a nature to be completely restored. But the statutes go further in many instances and specifically limit the amount of compensation which shall be paid for certain schedule injuries.

For instance, the statutes say that if a workman loses a foot he shall receive a certain amount of compensation extending over a certain period of weeks. Let us say that the law allows the workman 50 weeks' compensation for the loss of a foot. If the foot has been completely severed by the accident or has been amputated the workman should be able to resume normal employment within the period mentioned. Suppose, however, that he has not had his foot amputated, but has lost the entire use of it. It is the practice under such cases to award him compensation for the loss of the foot, 50 weeks as we have put it. In the course of time the 50 weeks are up and the workman is still unable to return to his employment. His foot is still useless and always will be, but in addition it causes him such pain and suffering that he cannot ignore it as he would an artificial foot. He is unable to walk on it because he has lost control of his muscles and it trips him. Just what is the measure of the disability of this man?

It is not possible to go into all the perplexing situations which are arising in industrial employment every day, but it is hoped that this discussion may serve to express the law in such a way that much of the doubt of the past concerning disability will be removed.

Meaning of Disability

Disability does not necessarily mean loss of earning power. It may mean more than that, and very often does. Disability means something more than loss of earning power, for a man may receive an injury and still be entitled to compensation. The mere fact that he is able to continue at his work and draw his wages is not the controlling factor, but it may be in the case of temporary disability, and it may not.

If a workman suffers an ordinary temporary disability so that he is unable to resume his work for two weeks, but has apparently received no injury other than a bad shaking up or bruising, his loss of earning power is the controlling factor in his right to compensation.

However, if the workman loses one of his fingers and has it bandaged up and returns to work in two days perfectly able to go on with his work his compensation cannot be denied him, because loss of earning power is not the controlling factor in his right to compensation. He has received a permanent injury which the law deems to have impaired his efficiency in a certain measure and the law awards him a certain scheduled amount of compensation for the loss of his finger. The workman, in such a case, may actually lose no wages whatever but still be entitled to draw his compensation.

The proper distinction then between disabilities arising in industrial employment is very necessary to employers, for it may mean a saving of money to them. Compensation should be paid when due, but it should be withheld when not due. To place one injury in the

wrong class may benefit the worker and harm the employer and it may harm the worker and benefit the employer.

While loss of earning power is not a controlling factor it is certain that some impairment of the worker's efficiency must exist if compensation is to be payable. An injury which causes no loss of earning power and which in no way impairs the efficiency of the workman in his employment is not a compensable injury within the meaning of the compensation acts.

In arriving at the question of whether disability exists a long line of decisions holds that the rating is to be made on the basis of the employment in which the workman was engaged at the time of his injury. He may still be able to carry on his duties in that employment without any impairment of efficiency and not be entitled to compensation unless he suffered a schedule injury, while in another employment he would be hopelessly inefficient.

It is impossible to hold employers for problematical impairment or to attempt to base a disability rating upon any other than the employment in which the man was at the time of his injury. Thus, to say that a machinist should have compensation for an injury which impaired his efficiency as a farmer, clerk or salesman would be manifestly unfair. He can obtain compensation only on the basis of his disability as a machinist unless he has suffered a schedule injury, which is entirely out of the hands of others than the legislative authority to determine.

Entitled to Full Compensation

However, if the machinist suffers a total disability as a machinist he is entitled to full compensation as allowed by the statute regardless of the fact that he might still have earning power in other occupations and might even make more money in such other occupation than he did as a machinist.

Many of the acts use the expression "incapacity for work" in this connection. A dispute has arisen as to just what the expression includes. Does it include inability to find work to do, as well as inability to do such work as the workman was accustomed to do prior to his injury?

In England it was said that the inability of a workman to walk to his work amounted to total incapacity and that he was entitled to compensation. In Massachusetts it was said that inability to obtain work resulting directly from the injury causing the incapacity was an "incapacity for work" within the meaning of the statute, while a like inability arising from another cause, such as an altered condition in the labor market, would not be. In one case a workman lost an arm, and it was held that he was entitled to compensation until he was able to obtain employment again, although he had during a portion of the time been physically able to work but could obtain no employment because one-armed men were not wanted.

The attitude taken by the courts is well expressed in the opinion of Cozens-Hardy, a British authority of international reputation: "The question which the judge put to himself appears to have been: Was the man able to earn the same wages that he was before the accident? I do not think that was the right question. The question should have been: Is he hampered in the labor market by reason of the accident? Is he not less likely to secure employment? If he is it would not be right to disentitle him from ever saying that his capacity was diminished by reason of the accident."

Very often workmen, especially those working with machinery, receive injuries which affect their muscular capacity and also cause mental pain and suffering. The muscular effects may be actually cured before their mental effects have been removed. If a man is able to return to work, so far as muscular capacity is concerned, but still believes that he is unable to work, a very nice question as to the duration of the disability arises.

Mental Effects of Injuries

The shock to the mental state of the man may amount to nervousness and fear—fear of the work which caused his injury. Until he is restored to his full vigor, both physical and mental, can he be said to have recovered from the effects of his injury?

Another quotation from Cozens-Hardy: "The effects of an accident are at least twofold: They may be merely muscular effects—they almost always must include muscular effects—and there may also be, and very frequently are, effects which you may call mental, or nervous, or hysterical. I cannot for the moment think which is the proper word to use in respect to them. The effects of this second class as a rule arise as directly from the accident which the workman suffered as the muscular effects do, and it seems to me entirely a fallacy to say that a man's right to compensation ceases when the muscular mischief is ended but the nervous or hysterical effects still remain."

The Massachusetts court has even gone so far as to say that the mere fact that a workman by the exercise of sufficient will power could have overthrown the effects of his nervousness and returned to work is not sufficient to deprive him of his right to compensation.

The question of whether such a distinction as is noted in the jurisdictions where the compensation is payable for "incapacity for work" would obtain in the jurisdictions where it is payable for "disability" naturally remains in some doubt, but the general assumption is that the two terms amount to the same thing and that such distinctions would obtain everywhere.

With these general considerations in mind we can now proceed to a discussion of the subject matter a little more intelligently.

Duration of Temporary Disability

In the case of temporary disability it is impossible to give a legal definition which will cover all of the states in which compensation is in force. Such definitions are found in the respective acts. It is possible to give one, however, which expresses in general terms the legal significance of the term.

In New Jersey it was said that temporary disability, as distinguished from permanent disability, is a condition that exists until the injured workman is as far restored as the permanent character of the injuries will permit.

The acts provide that so long as the workman suffers from temporary disability he shall be compensated according to a certain percentage of his "average weekly

wages," as set out by the acts, not to exceed a certain number of weeks. This figure is generally placed at 300 weeks. It is deemed that a man suffering from temporary disability should have recovered his normal usefulness within that time.

This very often comes within 100 weeks of the amount of compensation granted for a permanent disability. Employers are frequently unable to understand why the acts should allow nearly as much compensation for temporary disability as they do for permanent disability. The reason for this can best be shown by an example taken from an actual case.

Some Permanent Injuries

A workman received what was called a temporary disability under the law, but his injuries were permanent in some respects. In addition to the temporary disability he suffered as a result of the injury the following permanent injuries: (1) A fracture and dislocation of the right wrist, resulting in an enlargement which interfered with the use of the wrist and hand; (2) a fracture of the small toe of the right foot, which caused it to protrude in an unnatural manner and caused the workman considerable annoyance; (3) a fracture of the pelvic bone which shortened one leg, making the workman permanently lame, caused annoyance and occasional pain and interfered with his ability to carry on his work.

Because it was shown that the workman had been able to resume his former employment in spite of these permanent injuries and receive his former wages the trial court granted compensation only for the temporary disability; that is, for the time he lost from his work. The supreme court of New Jersey, however, held that this finding which refused to grant a reward for the permanent disability was erroneous.

Experience of Authorities

Unquestionably a man so injured is entitled to more compensation than his mere temporary loss of time would allow him. The long period of time allowed under the acts is for the purpose of taking care of workmen who receive injuries which require some time to heal, and the experience of the authorities is that the great mass of disabilities will be restored if given a sufficient length of time. If a man drags through several hundred weeks and still fails to recover his usefulness his injuries, which at first appeared to be temporary, may be found to have acquired a permanent character and an adjudication so made.

But it is seldom found that a workman who has received compensation for a long period as suffering from temporary disability can, upon a finding that his injuries are permanent, recover the full amount of compensation allowed for permanent disability. The amount of compensation he has received when his temporary disability took place is deducted from the statutory amount allowed for permanent disability.

A man may be technically entitled to compensation for temporary disability and for permanent disability at the same time, but he is not generally allowed to recover for both of them separately and independently. Such payments are deemed to run concurrently, he receiving compensation for the greatest length of time which the statute allows him for his injuries.

While this is sometimes not true, due to statutory enactment or judicial construction, in the main it expresses the rights and liabilities of the parties.

Temporary disability commences from the time the workman is incapacitated from work and extends until such time as he is restored to usefulness and earning power. It may even extend to greater lengths. It has been held in some states that it extends to the time that the workman is able to obtain employment, provided his inability to secure it is due to the injury.

But the period of temporary disability will not be prolonged through any fault on the part of the injured workman himself. If the man receives an injury to his leg, for instance, and is prevented from recovering his normal earning power and employment because of his failure to properly exercise such leg then there is no legal justification for prolonging the compensation payments. The California commission has so held.

Prolongation of Disability

This prolongation of disability is very frequently the case with workmen. They find it easier to receive compensation than to work, and they prefer, for reasons unto themselves, to prolong the period of payment just as long as possible. They know that when they return to work, having suffered no impairment of efficiency, their compensation will cease.

Malingering is not a compensable disability under the acts, and as soon as the workman commences to feign disability it is proper to cease the payment of compensation. This difficulty is more frequent in temporary disability cases than in any other.

However, if a workman is suffering from neurasthenia, a state of mind which has arisen out of his injuries, and, while able to return to work, honestly believes that he is incapable of working there is no justification in stopping the payment of compensation.

Malingering and neurasthenia are the two extremes of the normal difficulty with injured workmen in getting them to return to work after suffering from temporary disability. In the first case there are no methods too harsh to compel a workman to return to work. The employer is justified in stopping all payments when such a case exists.

But in neurasthenic cases the situation is vastly different. The workman is still suffering from a disability arising out of the injury, a nervous shock which has affected him quite as much as the loss of a member. He is entitled to compensation until he can be brought back to the normal usefulness of his mind, for he is still suffering from a compensable disability under the law. He is also an object of pity, for there is nothing more pathetic than a true sufferer of neurasthenia. Such cases should be handled only by the most competent medical men, and no efforts of coercion or force tending to induce him to return to work, as are justifiable with malingerers, should be practiced, as the probability is that the period of disability will be increased rather than diminished.

There is another situation arising in cases of temporary disability closely akin to malingering. It is what the Germans called "compensation hysteria;" that is, a desire for compensation. The workman feigns injury as well as disability in the hope of recovering compensation. The less said of this the better.

The mere fact that the injured member is sensitive or tender will not prolong the period of compensable disability. The Wisconsin commission has pointed out the fact that a workman must return to work even at the cost of inconvenience to himself or that his period of disability will be deemed to be at an end.

Compensation is not payable for further periods when it is shown that by the mere use of injured members the workman would be able to resume his employment. It is natural that even after the member has completely healed there should be some soreness and stiffness in it, but the employer cannot be held for compensation for mere inconvenience or pain. The man may actually be put to great inconvenience for a few days, but if his injuries have actually mended then it is proper to discontinue payments if he refuses to return to work.

What These Examples Show

These examples only go to show the need of each case being determined and governed according to the circumstances immediately surrounding it. If a man is unable to work he is suffering from "disability" or "incapacity for work." If he will be able to return to work within a course of time then he is suffering only from temporary disability, unless his injuries have been permanent in character, such as the loss of a finger or hand.

Where there is a true temporary disability the employer's liability dates from the time of the accident to the time the workman is restored to normal usefulness. The loss of earning power may be said to govern largely cases of this nature.

If the injury has been permanent in character, but the disability or incapacity from work only temporary in time, then the loss of earning power is not the controlling feature of the case, but the impairment of the workman's efficiency in the employment is the controlling feature, and the employer's liability will be based upon the schedules contained in the law.

It is hard to draw the distinction for the reason that few injuries received by workmen are clear cut in their application to the disability classes, but nearly always embrace one or two or all of them at some time in the history of the case.

Tool Grinding

By B. L. Van Schaick

In the old days when a foreman was a foreman because he was the most skilled worker in the department every man was allowed to go to a stone and grind or set his own tools. Then too every man was a real mechanic, stayed on the job for years and knew the "why" as well as the "how" of his work. The cribs were small, the tools comparatively simple, the various grades of high-speed and carbon steel unknown and the quantity production and accuracy of work demanded today undreamed of.

Under present conditions, with workers trained for certain operations only, and with a multitude of differing grades of steel, small tolerances and high-speed production, the more the grinding wheels are centralized the better the general results will be. The location of all tool-grinding apparatus in one or more maintenance cribs will reduce the percentage of rejections, lengthen the life of the tools and increase production. When a productive worker goes to a stone to grind a tool he not only loses productive time and allows his own machine to lie idle but he also wastes effort, for he cannot grind as well or as quickly as a skilled tool-repair man. In addition to the time lost greater damage is often done, as every worker has his own ideas as to how a tool should be ground and in suiting his personal fancy he turns out a tool that is not standard to the shop nor fitted for another worker's use.

Proper Grinding

In cutters especially, frequent proper grinding prolongs the life of the tool and increases production. The worker, if driven for production or working on a piece basis, is apt to lose sight of this and run a slightly dulled tool which leaves burs and slows down the work. Cutters should always be ground to blueprint by skilled tool men in order to obtain standardization of product, and care should be used in selecting the proper wheel for each particular job. The use of an improper wheel tends to burn or draw the temper from the thin edge of almost any tool, and grinding wheels therefore should be soft and free cutting, the cut always light and never forced. If the wheel is too soft its rapid wear makes it difficult to keep the cutter a true cylinder or to leave a sharp edge, and if too fine the wheel is apt to burn the work.

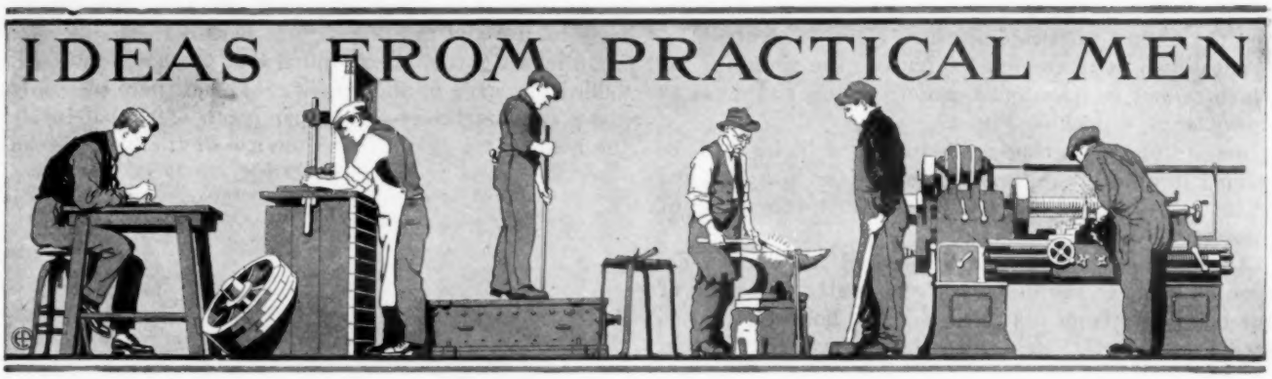
Although lathe tools seem at first glance to be less susceptible to centralization the reverse is usually true. One argument against individual grinding is the attitude of the workers themselves. Almost anyone who can run a lathe will apply for a job as a toolmaker at every opportunity. Give a man a lathe job for a few weeks and he considers it a slight not to be allowed to design, let alone grind, his own tools.

Reasons for Centralized Grinding

As a matter of fact there is less reason for allowing the individual grinding of lathe tools in a general machine shop than for the grinding of cutter wheels. Lathe tools are designed by a skilled tool designer for turning out a special part. A full set of tools is designed to complete the part, and even though they may be used on various machines the parts must assemble properly. Allow a worker to change a tool by grinding and the assembly department will begin to have its troubles, as the process inspectors will condemn the goods. Ordinary common sense should tell us that the best brains are selected to design the tool in the first place, and that if the worker knew better he would have the designer's job.

Another reason for centralized grinding is that no lathe tool should be ground without a print or gage if standardization is to be maintained and it is not practicable to have a complete set of tool drawings available for every operator.

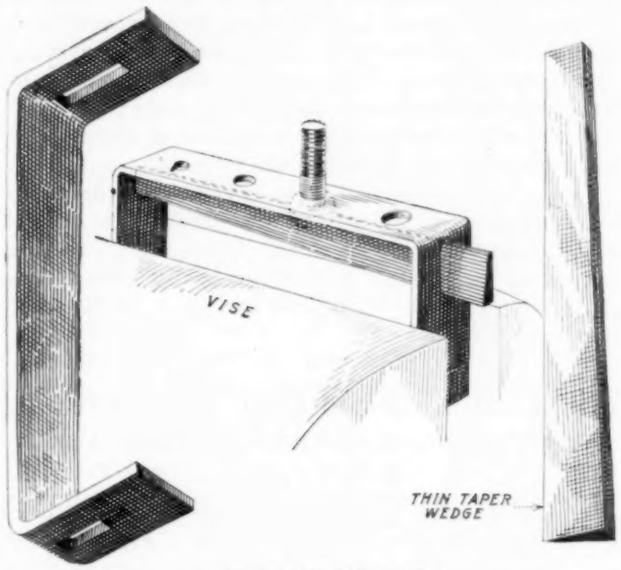
A central tool-maintenance crib will also develop valuable records as to the comparative life of different makes of tools and grades of steel. A tool which would be scrapped by a worker is reground and issued as a new or different type of tool by the skilled toolmakers of the crib. In 99 shops out of 100 a centralization of all tool maintenance and repair will prove a profitable investment.



A Vise for Holding Small Screws

By Charles H. Willey

This simple device is worth adding to the bench-vise attachments. It is made from a piece of ⅛ x 1-in. flat stock. The top edge of the wedge must be made nar-



A VISE FOR SCREWS

row enough to fit the slots in the heads of the screws, for it is this that holds them from turning.

Making 25 5-In. Sine Bars

By John Teckeer

Recently I had 25 5-in. sine bars, as at *A*, Fig. 1, to put through the toolroom. The number was just sufficient to appear worthy of specials and not great enough to warrant them. Thinking the job and method used may be of interest and possibly some benefit to your readers my solution is here given in detail, designating the time on such articles as tools, operations, etc., and disregarding the time on operations that were not a factor in deciding any special requirements. Also bear in mind this job was done in the toolroom of a contract shop, where there is no repetition work to any extent, and all jobs move at toolmaker's speed, which, to say the least, is variable.

The advantage of checking each operation cost with and without specials rather than comparing the aggregate figures is readily apparent. First I lay out the operations, study them and decide on probable opera-

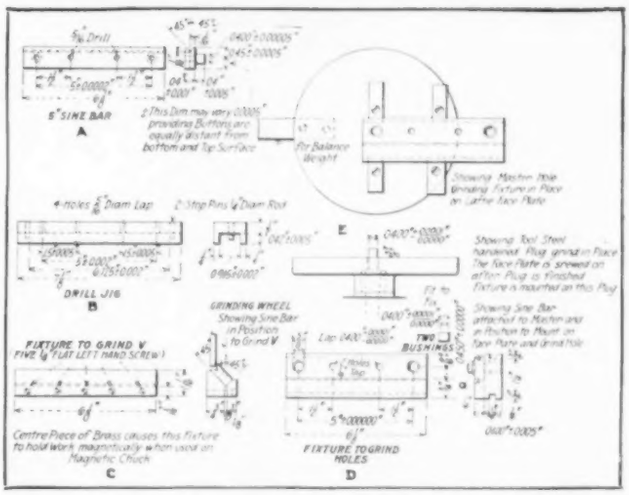


FIG. 1. THE SINE BAR AND THE TOOLS

tions wherein time can be saved and quality improved, as shown in Fig. 2. Those that appear worthy of specials I bracket and roughly sketch the suggestion in mind.

Using this as a key I develop the ideas to completion, and set down on comparative sheets the results in time, labor and material to be expended both with and without special tools. This, with impartial judgment of the merits of each method, decides the operations as shown in Fig. 3. We find the formed cutter and fixture for

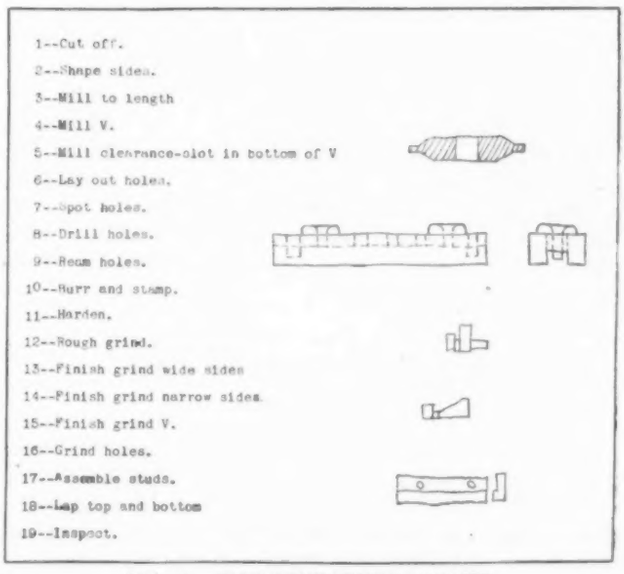


FIG. 2. THE TENTATIVE LAYOUT

grinding the narrow sides eliminated, but the drill jig and the fixture for grinding the Vs are warranted.

These two, with the master fixture, the necessity for which cannot be questioned, are drawn up and made as shown at *B*, *C* and *D*, Fig. 1.

Regarding the grinding fixture, the holes can be ground in an average time of 3 hours for each bar, and I feel that a description of its construction may be of interest.

The making of this fixture required the highest degree of skill, as the distance from center to center of the holes, and from the centers of the holes to the surface *a* (sketch D, Fig. 1), was held practically without

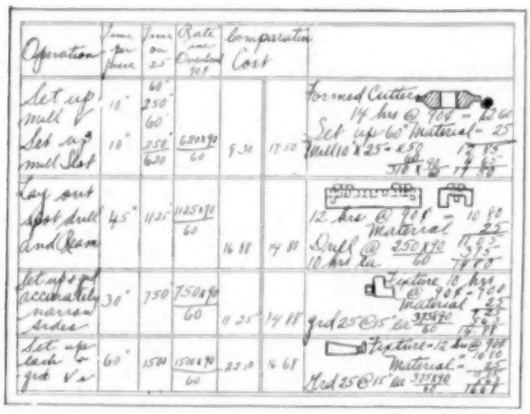


FIG. 3. THE COMPARATIVE COST SHEET

tolerance. Holding the master to these limits led us to assume that it would duplicate itself within 0.0002 in., which was the greatest tolerance permissible on the completed sine bars. Cast iron was used for the fixture body and was shaped to form.

The master holes were buttoned and bored to $\frac{3}{4}$ in. diameter, leaving 0.005 to finish on surface *a*. The distance between centers was made as nearly perfect as could be accomplished. The hardened and lapped bushings were then inserted and finish-lapped to 0.400 in. diameter. The bushings were indicated for parallelism, using a 5-in. radius trammel, and held within 0.0005 in. of indicating true. This on the bushing length amounts to 0.000025 in. on each bushing, or a possible collective error of 0.00005 in. The fixture was then ground all over in proper relation to the holes and the 0.450-in. dimension finished last.

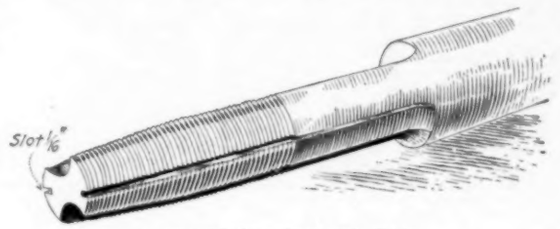
To use on the bench lathe a plug was ground and lapped in place, as shown at *E*, Fig. 1, to 0.400 in. in diameter, the faceplate being put on afterward. The fixture, with the sine bar attached, is then slipped on the peg and the hole is ground. Without moving the sine bar the fixture is then reversed and the operation completed. The finished plugs were then inserted and the job was ready for inspection.

A Special-Purpose Tap

BY A. KIRBY

In the course of our work difficulty was experienced in tapping a 0.202 x 36 United States Standard thread to a 0.003 limit. At first we used a high and low thread gage, but found when the screws were assembled that many would not screw down tight, but slipped as though the thread was stripped, although the screws were to size and the tapped hole passed the gages.

On investigation it was found that the holes had been drilled too large or the tap clogged, and there was only about one-quarter of the proper depth of thread inside the hole, so we discontinued the use of the high thread



A SPECIAL-PURPOSE TAP

gage, and used in its place a high plain-core gage so that the low gage was to go in and the high core gage not go in.

Then our troubles commenced. We tried every known means to stop the tap from clogging (we were tapping soft brass); we tried tapping them dry and we tried various kinds of lubricant, but it was of no avail.

As an experiment I had a tap made with only two flutes of standard depth and width, and, with a $\frac{1}{16}$ rubber wheel ground a flute in each land about 0.010 in. deeper than the bottom of the thread.

This ended our trouble. The land being wide had a steadying effect on the tap and the narrow flutes ground in each land broke up the chips. Whenever I have fine threads to tap in soft metals, especially where close limits are required, I now use this style of tap with satisfactory results.

The Graphical Solution for Clearance Angle of Form-Ground Thread Tools

BY S. C. BLISS

A problem often encountered in the design of form-ground thread tools of the type shown in Fig. 1 is that of determining the clearance angle *C* necessary in order to avoid interference of the tool edge *e* with the surface of the thread helix.

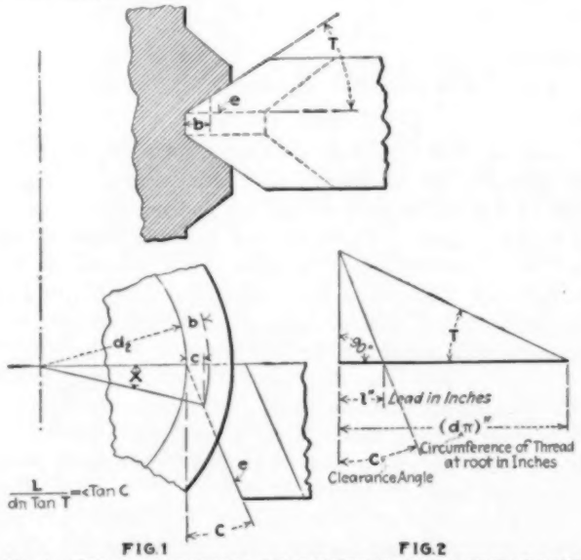


FIG. 1 FIG. 2

FIGS. 1 AND 2. METHOD OF DETERMINING CLEARANCE ANGLES ON THREAD TOOLS

Referring to Fig. 1 let d equal the root diameter of the thread in inches. Let l equal the lead of the thread in inches.

Then $\frac{l}{d\pi}$ equals the tangent of the helix angle H. Let T be the angle between the side of the thread and a line drawn perpendicular to the axis of the screw. Let x be the value of the angle X expressed in radians.

In order to avoid interference: I. $\left(\frac{d}{2} + b\right) x \tan H = < b \tan T$.

From Fig. 1 we have: II. $\left(\frac{d}{2} + b\right) \sin X = \frac{C}{\tan C}$.

Dividing I by II we get: III $\left(\frac{x}{\sin X}\right)\left(\frac{c}{b}\right)\left(\frac{\tan H}{\tan T}\right) = < \tan C$, and when the angle X becomes infinitely small we get the following equation, which is the solution of the problem:

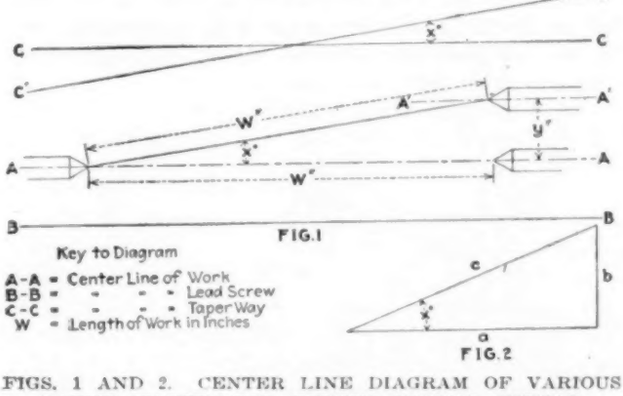
$$\text{IV } \frac{\tan H}{\tan T} = < \tan C, \text{ or } \frac{l}{d\pi \tan T}.$$

Fig. 2 shows the graphical solution of equation IV for the value of the clearance angle C. It is advisable to make the clearance angle on the tool slightly larger than C. This solution is correct for both external and internal threading tools. In using it for internal-threading tools it should be noted that d is the root diameter of the thread.

Cutting Threads of Unusual Pitches

By Miles C. Smith

In the jobbing and maintenance shop occasion often arises to cut a thread of so uncommon a pitch that we have no lathe equipped to handle it. Of course we could make a new gear to comply with the requirements, but an easier and much less expensive way is to utilize the taper attachment in combination with an offset of the tailstock. In this way we may set our lead screw at the nearest approach to the lead wanted and make



FIGS. 1 AND 2. CENTER LINE DIAGRAM OF VARIOUS LATHE CENTERS FOR CUTTING SPECIAL THREAD

up the necessary error, at the same time cutting a perfect thread.

This method is no doubt familiar to those of the trade who are widest awake, yet I have never found anyone who employed a formula to set his lathe but set it by trial, so I will give a formula which will be found to be absolutely accurate and will also show its derivation.

Fig. 1 gives the center lines of all the essential factors with the taper attachment and tailstock in both their normal positions and in the positions they take to accomplish our purpose. We know the values of all except x deg. and y in. They may be found by solving the following formula:

The cosine of the angle x is found by dividing the number of threads per inch required by the number of threads per inch nearest it on the lead screw. From a table of natural angle functions or by laying out the triangle we find x in degrees. Then taking the natural function of the sine of x deg. and multiplying it by the length of the work in inches we have y, or the required throw of the tailstock in inches.

Let n = Number of threads to the inch on the lead screw, and

n' = Number of threads to the inch required.

Then the length of one thread on the lead screw would be $\frac{1}{n}$ in. and the length of one thread required would be $\frac{1}{n'}$ in. Now if we take the small right-angle triangle in Fig. 2 and substitute for the side a, $\frac{1}{n}$ and for the side c, $\frac{1}{n'}$ and solve the triangle for the angle x, we have $\cos . x = \frac{a}{c} = \frac{\frac{1}{n}}{\frac{1}{n'}} = \frac{n'}{n}$, two values we know.

Solving this will give us the natural function of the angle x by which we find x the angle necessary for the throw of the taper attachment and the angle the work must be thrown off the horizontal to accomplish the desired result.

To find y we take the same small triangle, and for the side c we substitute W in., the length of the work, and for the side b we substitute the unknown y and solve for y, letting the angle x remain the same angle which we now know the value of in degrees. Then $\text{Sin} . x = \frac{b}{c} = \frac{y}{W}$, which gives us the value of y in inches.

This may seem rather complicated for the average machinist, but when we consider that every handbook has a table of natural-angle functions and that if no handbook be available it is but a few moments' work to lay out the two triangles with square, dividers and protractor, and also considering the time saved from the old cut-and-try method, it will be found to be well worth while. The two formulas could be combined and one solution would give the throw of the tailstock from which the taper angle could be easily found, but the two simple formulas seem to me to be the most useful.

We wish to cut 19 threads per inch on a machine screw which measures $6\frac{1}{2}$ in. over all. Our nearest lead on the lathe index is 20 threads.

In this case $n = 20$, $n' = 19$, $W = 6\frac{1}{2}$ in. Cos. $x = \frac{19}{20} = 0.950$; from which $x = 18$ deg. 10 min. Now taking the natural sine function of 18 deg. 10 min. which is 0.3118 and substituting again,

$0.3118 = \frac{y}{6\frac{1}{2}}$; $y = 2.026$ in., or approximately $2\frac{1}{32}$ in. Then setting our taper attachment at an angle of 18 deg. 10 min. and throwing our tailstock over $2\frac{1}{32}$ in.

we will be ready to go ahead and cut our thread in the usual manner with our index gears set for 20 threads per inch.

The principal factor in this setup is to be sure that the center line of the work and the working center line of the taper attachment are absolutely parallel, otherwise the thread cut will be imperfect.

Efficiency in Crating Machinery

By J. V. Hunter

Machine builders as a rule make every effort to obtain the maximum degree of efficiency in building their machines, but after the machines are finished and have passed final inspection too often efficiency ends before they get to the crating department, or boxing room, as many term it.

In the plant of the Ransom Manufacturing Co. at Oshkosh, Wis., however, efficiency has been extended even to crating its grinding machines. The steel framework shown in Fig. 1 is for storing the lumber that is required for crating these machines. It has a separate section for each of the standard sizes of lumber used the heavier pieces being on the right-hand side. When removed from the rack they fall on the crosspieces *A*, which are on an exact level with the saw table, and the lumber may be slid along to the saw without further lifting effort.

The saw and its table are shown in Fig. 2. The saw was designed and built by the Ransom Manufacturing Co. and has remarkably easy motion in its forward and backward swing. The table is of special interest. It has been laid out with the spaced holes *A* in an iron plate, so that the operator using the adjustable block *B* for his lengths of lumber need never stop to make a measurement. The stop block has two pins on its lower side, which fit in the holes in the table, holding it firmly in position during cutting of the lumber pieces.

The finishing touch of efficiency is obtained by the series of data tables seen at *C*, one for each size of machine manufactured and each detailing the number of pieces and size of lumber required for that particular crate. Each table gives the complete list of parts for a machine. In reality there are two crate lists for each machine, one for domestic shipment and the other for foreign. Working from this list the operator pulls the required size of stock from the rack, sets the gage on the saw table for the proper length, and in a short time has all of the pieces cut for a complete shipping crate.

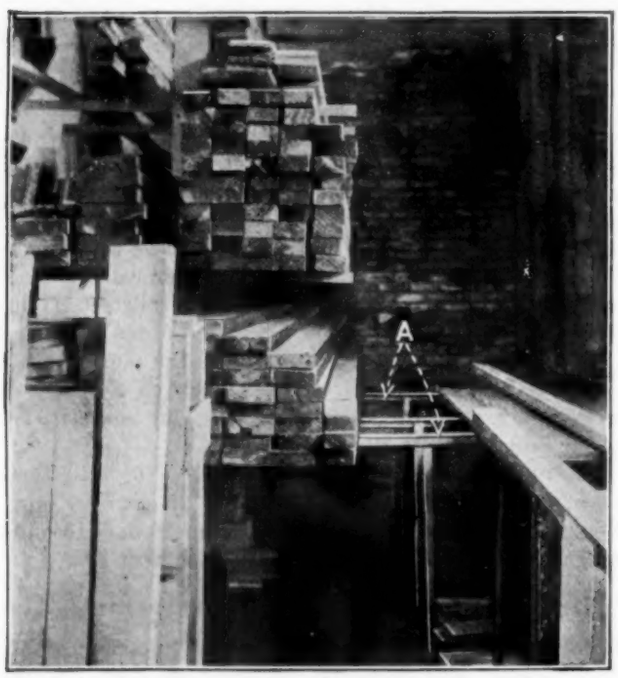


FIG. 1. STEEL-FRAME RACK FOR LUMBER STORAGE

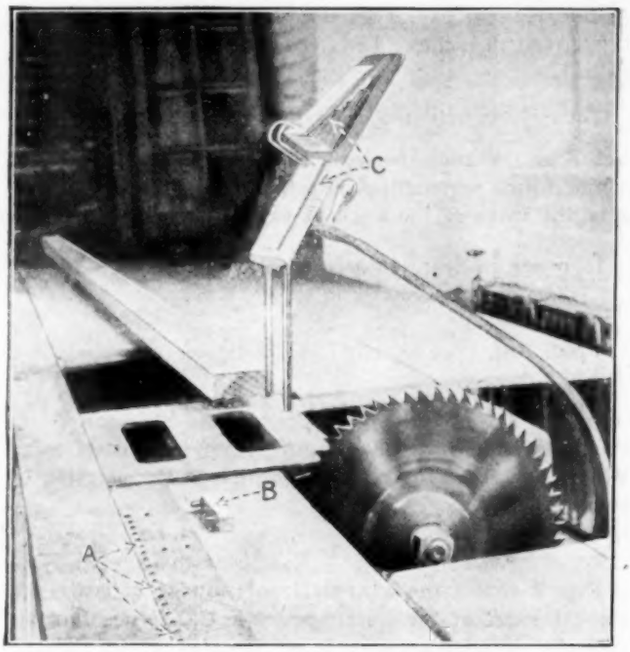
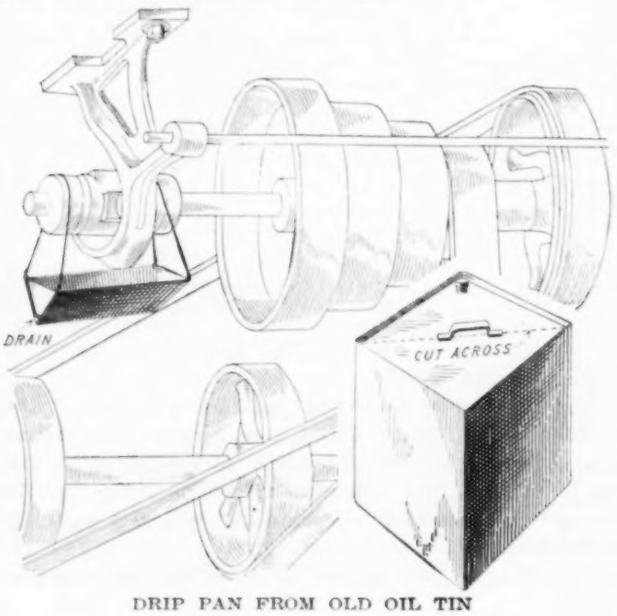


FIG. 2. THE SAW AND TABLE

Use for Old Oil Tins

By Charles H. Willey

The sketch shows a good use for empty 5-gal. oil tins such as are used for petrol, automobile oil, etc. The can is cut across, as indicated by the dotted line, and the half that has the screw cap on it is suspended with wire from the hanger bearing.



DRIP PAN FROM OLD OIL TIN

Optical Projection for the Inspection of Screw Threads—I

By JAMES HARTNESS
President Jones & Lamson Machine Co., Vice Chairman National Screw-Thread Commission

In this article, which is reprinted from "Mechanical Engineering" (formerly the "Journal of the American Society of Mechanical Engineers"), the author gives an analysis of screw-thread elements essential to strength and dependability. In the second installment a description of a new and improved optical method for their accurate inspection will be presented.

THE screw, one of the most important elements in mechanism and found in nearly all forms of machinery, is invaluable as a means of fastening two parts together, as a means of precision adjustment and as a means of transmitting power.

In machines in which the weight must be kept as low as possible, as for instance in the airplane, it is of prime importance to have the screw as small as consistent with the strength and reliability required.

On account of the vagueness of our general knowledge of the conditions under which it takes its stress we frequently underestimate the importance of the screw, and through ignorance continue practices that greatly increase the hazard of life in travel by rail, automobile or airplane, as well as lessen the reliability of performance of other pieces of machinery. A screw-thread fastening is very dependable if the two component parts are properly fitted.

Analysis of Various Elements

While it is not possible to attain perfection in this work an analysis of the various elements that are essential for strength and dependability and the reduction of weight will greatly simplify our efforts and make it possible to attain a point much nearer perfection.

Briefly stated a screw's reliability depends upon the following elements: (1) Material; (2) form of profile of the thread; (3) diameter of the screw; (4) lead or the number of threads per inch.

After the foregoing general characteristics have been determined we must consider the following details which depend on the methods and skill employed in production: (1) Smoothness and density of surface; (2) fit, which relates particularly to the exact relationship of the size of the two component parts; (3) precision of lead, which relates to the precision of advance of the helix or degree of precision with which the number of threads per inch are made; (4) uniformity or steadiness of advance of helix; (5) form, relating to contour of a single thread; (6) roundness, as relating to the circular path of the helix; (7) parallelism or taper. These elements are all interrelated.

Modern practice in constructing machinery is drifting more and more toward absolute interchangeability of parts. In the older practice it was customary to fit one part to another, either by doing the final finishing at the time the parts were assembled or by selective process, such as picking out the larger screws to be used with the larger nut or tapped holes and smaller screws to be used with smaller holes.

To a certain degree this method of fitting at the time of assembling, either by changing the sizes of the parts that go together or by selective process, is still necessary in the highest requirements of very close fits, but the trend is strongly toward perfect interchangeability.

This requires working to stated standards so that the size of the thread of the screw and nut will never exceed certain boundaries. But whether the boundary allows no freedom when the largest screw is turned into the smallest nut or a certain predetermined freedom of play there still remains the necessity for determining how large an internal thread may be made and still be acceptable, and how small the screw may be made and still be acceptable; in other words, what is the greatest degree of looseness that can be tolerated without impairing the dependability of the screw and nut for service.

Projection Lantern a Better Method

Thus far we have had no satisfactory way of specifying all of the elements that are required to make a screw dependable, but we are now finding that the projection lantern offers a better method and makes it possible to simplify specification and practice.

It will be understood that the largest percentage of screws must be made with sufficient play to make it possible to screw them together rapidly by hand and resort to the wrench only for setting them up to full tension. This is essential for convenience of assembling, which is an important part in the production of the machine and for the use of the product in service.

As an example we may take the bolts of the demountable tire rims of the automobile wheel. The nuts for these bolts should be a reasonably good fit. At the same time, in order to get quick interchangeability, they must not fit too close; that is, they must turn with a certain degree of freedom; yet the service they render is so important that they must be a little closer than a wringing fit, but must not be a tight wrench fit, at least at the outer end of the screw. While the limits of a screw fastening for this service are very small the case illustrates the fact that a given degree of freedom of play is necessary, but must not exceed a certain boundary. In certain kinds of agricultural machinery, for instance, a much larger freedom may be tolerated, and in fact is desirable.

The gaging not only determines this boundary line, but also establishes another boundary line which constitutes the maximum freedom of play of the two components.

For instance, a ¾-in. 10-pitch screw, nut and bolt, measures ¾-in. at the largest diameter (called crest of the thread) of the bolt, but since the crest is not of

great importance we measure the screw at the flanks of the thread with V-point calipers. This we call the pitch diameter, expressed P. D. The P. D. of a full-sized ¾-in. bolt is 0.6851 in. This we call the basic diameter for this thread. In general practice it constitutes the maximum size for a close-fitting screw, and in some instances the smallest size of the nut. In other instances, the smallest nut is made a few thousandths of an inch larger in order to give a certain degree of looseness. If the smallest nut is made to this basic size then this figure becomes the minimum boundary of the nut and the maximum boundary of the screw.

Since it is not practicable to produce screws of exact uniformity it is customary to allow a certain range of variation. The range of variation is expressed in thousandths of an inch of tolerance. For instance, for fairly good work we allow a range of two and one-half thousandths of an inch, usually expressed as 0.0025 in., and sometimes given in exact size, such as in this case would be 0.6826 in., which is 0.0025 in. less than basic size, 0.6851 inch.

The Tolerance of Variation in Diameter of the Nut

The tolerance of variation in diameter of the nut in the same way is expressed as 0.6851 in. as minimum size plus 0.0025 in. for maximum of 0.6876 in.; or if there is to be a neutral zone between the largest screw and the smallest nut then the smallest screw may be any size that meets the requirements, 0.006 in. being a certain ordnance practice for neutral ground. Then the P. D. of nut becomes 0.6911 in. for minimum to 0.6936 in. for maximum, the tolerance of variation of product remaining the same, 0.0025 inch.

In the old practice of fitting one piece to another or even in the selective fitting it was a comparatively easy matter to keep within certain boundaries between two pieces, but in the new practice, if the total freedom of play between two parts is 0.004 in. and the minimum freedom of play between two parts is 0.001 in., we will see that it is necessary to have 0.001 in. for the neutral space and divide up the other 0.003 in. in tolerance in variation in the sizes of the two component parts of the screw-thread fit. If the tolerance is equally divided between the two parts this makes a total variation of 0.0015 in. that will be tolerated in the nut and 0.0015 in. tolerated in the screw.

The interchangeability system therefore imposes upon us greater precision in uniformity of production in order to get this interchangeability; but notwithstanding this important handicap the advantages of the interchangeability system are so great as to offset the disadvantages. In fact a high degree of interchangeability brings a reduction in cost of product and a greater reliability.

The purpose of our gaging is to guide us in manufacturing these parts and to serve as a means for finally inspecting the work before it is put into service, for if a screw, for instance, is made by one manufacturer or department and sold to or delivered to another manufacturer or department the screw must be passed on by suitable gages to determine whether or not it comes within specified boundaries.

The form of the United States Standard thread, originally known as the Sellers Standard, is made by a cutting tool having an included angle of 60 deg. This tool is truncated or flattened off at the end to an extent that amounts to one-eighth of its travel per revolution. The top of the thread has a similar flat, and although this describes a perfect thread it is well known that a perfect thread is seldom found in practice. Therefore it is our object in gaging and inspection to measure not only the diameter and the various parts of the screw, but also the truth of the helix for a given advancement per revolution, the degree of departure of the screw thread from the specified 60 deg. of angle, and in fact each characteristic on which its form and reliability depends.

Threads are specified as having a lead of helix expressed by the number of threads per inch. For instance, a ¾-in. United States Standard screw has 10 threads per inch. It is essential that there should be as nearly as may be exactly that number of threads per inch. If we count off 10 threads on a screw and find that we have advanced more or less than 1 in. we say the lead is not true; that it is off so many thousands of an inch.

If the lead of a ¾-in. screw is off more than 0.003 in. or 0.004 in. per inch of length of engagement it is unsuited for the best work, for when screwed into its threaded hole, which we will assume is accurate, the threads will not match; consequently if they are approximately the same size the two may not screw together. But let us assume that the diameter of the inner member is enough smaller than standard to offset the difference in lead; then although the two may screw together they become less dependable when subjected to stress than if the threads of the two component parts matched each other, for it is obvious that there would not be an equal distribution of the stress of the work on the various threads that should be engaged.

Determining the Roundness

Thus it will be seen that we not only have to consider the diameter but the lead, and in addition to this the form of the thread; that is, the form as shown by taking a profile that shows the flats of the angles of the sides. Then, since the helix may not proceed uniformly, may stagger forward, producing a thread which is known as a drunken thread, we must know about the degree of uniformity of this advance.

Besides this we have to determine the roundness, for die-cut threads are frequently out of round, due to excessive clearance of the cutting tools and inequality of distance between the two pairs of cutting edges in a die having four cutting edges.

We have also to inspect the screw for character of its surface. A die-cut thread, especially threads of 10 pitch and coarser, may be very rough and a microscope may show its surface as mountainous.

Furthermore, in addition to the measurements and character of its surface, the entire surface, including the tops and sides of the mountains, may be, as expressed by one authority, "like a plowed field," as a result of the action of the cutting tools which instead of cleanly removing the metal have pushed or torn out the metal as if pulled out by the roots. This analogy of course is not perfect, but it gives a fairly true conception of the character of the surface, especially of a screw that has been produced by a single passing of the die.

Although some screw-cutting dies are designed to supplement the cutting process by a burnishing process which levels the mountains and compresses the plowed-field surface the fact remains that nearly all screws of pitches coarser than 10 or 12 per inch have rough surfaces.

It is customary for the inspector to pass on surface characteristics by close scrutiny. If it appears smooth the screw is accepted, and if it is unduly rough for the service for which the screw is to be used it is rejected.

Deficiences of the Usual Gaging Methods

The process of gaging screws by the use of ring gages for the screw and the plug gage for the threaded hole is far from satisfactory for many reasons. The best practice uses at least two gages for each part. In gaging a screw, for instance, two ring gages are required. One is the upper boundary of size into which the screw must easily turn with a finger fit, the other gage is the lower one into which the screw must not enter more than one or two threads, according to the condition of the gage and the work.

In still finer practice other gages are used to determine the lead, form and diameter of the crest and root, but in all such gaging processes the gage merely rides over the tops of the mountains, so far as the surface is concerned, and the extremes of the irregular helix, so far as the wabbling of the lead is concerned. Thus it will be seen that even with the best practice in use of the ring and plug gages the process of gaging does not give a true indication of the dependability of a screw as a means of fastening.

A ring gage which is used for testing screws may become deceptive by the possibility of a fine, thin chip becoming lodged at some invisible point in the valley of the thread. For instance, if this is a no-go gage, and if the practice of the plant is to allow a screw to enter one or two turns into the no-go gage on account of the wearing of the gage, a screw may enter until it encounters a chip of this kind, and then since it can go no farther it is passed as acceptable because it will not enter the no-go gage beyond a specified distance for that particular gage.

The other elements of uncertainty readily come to the mind of one accustomed to precision measurement, and it is not necessary to go into all of these details.

In addition to the ring gages we have the adjustable caliper in the form of the regular micrometer and the thread micrometer, and the fixed calipers, in which the points, although adjustable, remain fixed so far as the workman is concerned. These calipers, whether fixed or adjustable, give the diameter of the thread, usually measuring it on the flank, but this diameter does not give a true indication of the roundness of the screw. For instance, if the screw is die cut the advance of the cutting of the die may be irregular, so that although any two opposite points in the diameter of the screw may be uniform to a certain measurement, as a matter of fact the screw has wabbled in passing through the die so that it has a series of longitudinal flutes or waves of more or less amplitude.

The caliper points for such work will find substantially a uniform diameter, although on one side one point may be resting on a crest, while on the other side of the work the other point may be in a valley.

In the usual methods of inspecting there is also to be considered the personal equation of the inspector.

We speak of loose fits as very loose, or with very little shake, or still closer with no shake.

Close fits are designated as finger fits when they can be turned on with the finger, as wringing fits when they require a litle greater force, and as wrench fits when they require more force than can be exerted by the hands without the aid of a wrench.

These are some of the shop terms that are in common use between men who are skilled in the work of making screw-thread fits of a dependable kind. They were fairly satisfactory between men skilled in this work, but they become misleading when put in general use.

To the skilled worker they meant that the fit for two component parts of a screw-thread fastening that were of known lead, shape of thread and fineness of finish should be made to satisfy this tactile test, but the tactile test leaves the science of screw-thread gaging in a most difficult situation, especially with the modern advance in which specialization has so divided the work that the various parts of a piece of mechanism may be made in different cities. A screw, for instance, may be made in one city and the threaded hole into which it fits be made in another city.

When we realize that for a close fit the total allowance is extremely small and wholly disappears by the usual variation in machine product we begin to see the difficult situation that has come with the higher development of machine construction, and we see that this tactile method, which depends so much on the personal equation of the individual inspector, leaves the producer always in doubt as to what will be acceptable, for he has no positive indication of the ruling of the purchaser.

Gages Do Not Definitely Determine Shape and Character of Thread

What has been said thus far applies merely to gaging screws that are known to be correct both in form and finish of surface. A simple plug or ring gage gives no indication of the exact form of a thread. In fact when these gages are supplemented by others cleared at the root and crest we are still in doubt as to the form of the effective surface. With this important element unmeasured our gaging system is incomplete even if it were satisfactory in other respects.

Thus far also we have considered the two component parts of a screw-thread fastening as if made of material that was neither elastic nor plastic. If this were true our screw threads would be most undependable, but since it is not true, and since the threads of the two component parts may be forced together under wrench or subjected to the stress of work, the engaging flanks of the threads of the two component parts are gradually squeezed into fitting surfaces. The stress levels the mountains and compresses the surface, and if the angles of the flanks of the two threads are not similar this stress to a certain degree compresses the metal into a shape that gives perhaps a nearly perfect form of contact.

This squeezing changes the size and form of the thread surface and hence our gages cannot indicate what the shape and diameter of the screw will be when these mountains have been leveled and the plowed-field

surface compressed by the action of the working stress. Our gaging method is such that we must never exert pressure that will level down this surface, for by even the most careful use the gage wears out of shape and it is considered very bad practice to force a gage.

Thus it will be seen that although we use our greatest care in the measurement of the screw thread as it comes from the machine in which it is produced our gaging system makes little recognition of the shape, form and dimensions of that screw after it has been put under its working stress. It must be remembered that nearly all screws, excepting those used for precision adjustment, must be subjected to considerable stress in service and that the end and aim of our gaging system should be to determine the fitness of a screw for its service.

Screw-Thread Requirements in Advanced Practice

The advancement of the art which has come about through the development of the bicycle, the automobile and the airplane has reached a point in which it is absolutely necessary to inspect screws in a way that will give a much better indication of their dependability. Before the art had advanced to the point where it was necessary to obtain the greatest strength for a given weight a simpler system of gaging was satisfactory, but now, to make the most dependable airplane, a screw thread should be gaged for form, diameter, pitch, roundness and compactness of surface. The gaging should be done with full consideration of the changes that are produced in the lead, form and diameter when subjected to the working stress.

It seems probable that with the advance of requirements in machine construction we must go a step further in our gaging methods and make use of the projection lantern to help us solve our screw-thread gaging problems. The optical method of inspection and measurement of screw threads by the use of microscopic apparatus and projection lantern has been found invaluable in inspecting gages, but it has not been generally used for the inspection of the work itself.

The Touch Method of Inspection

The tactile, or touch, method of inspection does not give us a true indication of the form of a screw, and even with a variety of instruments it gives only an approximate conception of the lead.

Notwithstanding the shortcomings of the ring and caliper types of gages they still remain among the most practical gages in the workman's hands, and although the projection lantern brings the gaging to a definite science and should be the basis of specifications for screw threads and the final arbiter in accepting or rejecting the product its function is more to keep a check on the simpler forms of gages than to supplant them.

For instance, the first and last pieces of a lot of die-cut screws should be tested by the lantern. A change of dies, either through wear or important adjustment, should be checked by sending a sample screw to the lantern. This, supplemented by the percentage test of the final product, would be sufficient check, for it would give a definite knowledge of the character of the form, lead, roundness, etc.

Who Was the Victim of This Joke?

By H. H. Armstrong

In the days of my apprenticeship in the old machine shop there were times that the boss was too busy to find work that was suited to my limited ability and on such occasions I was allowed to ramble around the shop and pick up such points as I could on my own initiative. During one such period I asked the repair man if he had any thing I could do. His reply was affirmative and he handed me a hexagon-head bolt about 1¼ in. in diameter by 8 or 10 in. long with the request that I get it hardened.

Glad of the opportunity to pay a visit to the blacksmith shop where I, like the children in the poem, delighted to "see the flaming forge and hear the bellows roar" or something to that effect, I put on my hat and coat and, seizing the bolt, departed.

As I left the room I noticed that several of the men were looking in my direction and laughing, but I did not connect their merriment with my mission—then. Arriving at the blacksmith shop I hunted up the foreman, showed him the bolt and told him what was wanted. He directed me to a workman who presided over a nice hot fire and to him I took the bolt and the order. The blacksmith put the bolt in the fire, leaving one end sticking out, while I sat down on the edge of the quenching tub to watch the proceeding.

Pretty soon I noticed that the visible end of the bolt was taking on a peculiar appearance and was settling down into the fire. Also an unwarrantable amount of blue smoke was being thrown off. I called the attention of the blacksmith to this, upon seeing which he grabbed the bolt with his tongs and yanked out of the fire what there was left of it, for the erstwhile bolt had been made of lead.

The blacksmith spoke very rudely to me, and I could not think of telling you the words he said, but during his discourse his features suddenly took on an appearance of perturbation and his flow of language stopped, while a chill crept into the atmosphere and down the back of my neck as I turned around to find the superintendent standing behind me.

Explanations were in order and I was made to understand that somebody had been made the victim of a joke, but I don't know yet who it was. And when I told the repair man all about it and that the superintendent was going to call him up to the office to explain how it happened, he didn't know either.

Drafting-Room Kink

By A. R. Anderson

Draftsmen who have occasion to make drawings in which there are a considerable number of radii of 1½ in. or more realize the difficulty of obtaining a pencil point for the compass which is sufficiently hard to hold the necessary sharpness yet at the same time soft enough to produce lines that can be plainly seen by the tracer. When the tracing cloth is placed over a drawing the tracer sometimes finds it hard to decipher it and wastes valuable time in discovering the trouble. If all such radii are inked in with fine lines much time will be saved both by tracer and draftsman, for no confabs will be necessary to explain the drawing.

Forty Million Dollars
Worth of
Machine Tools for France!

George N. Peek of the War Industries Board, writing under the date of February 19, says:

"We have a cable from Mr. Baruch indicating that the French government is willing to allow sales to French merchants of forty million dollars' worth of machine tools conditioned upon commercial credits being arranged for one year.

"By this we understand that it is the intention that individual American companies are to deal directly with the individual French companies under the same conditions as formerly existed, except involving deferred payments."

EDITORIALS

Human Interest in the Shop

IT MAY be safely said that the main concern of the machine-building industry is economical production, and as economical production depends upon several factors the successful manager must understand and appreciate them all.

Machine equipment and manufacturing methods play an important part in economical production. But without an adequate corps of trained workers the best machine equipment is of little value.

Proper supervision of men and methods and enough system to keep things running smoothly but not to hinder, as is too often the case, are also necessary factors in the successful prosecution of any business.

We have been devoting our attention very largely and very successfully to mechanical methods and to systems for handling the routine of business. We have paid less attention to the human factor and to the changing trend of thought along these lines.

That we have not been idle is shown by the improved sanitary conditions of our shops, in the attention now being paid to the lighting, heating and ventilation of our industrial establishments. We also have laws dealing with accident prevention and compensation. These have come into being in spite of opposition in some quarters, but no one would now wish to have conditions changed back to old-time conditions.

Those of us who remember washing up in buckets or common troughs which were used by dozens of others would probably appreciate the modern shop washrooms more than does the present generation. But few of us can on the other hand appreciate the new spirit, or lack of it, which has become a part of many large manufacturing institutions. We have subdivided the shop work and devised ingenious fixtures to enable the employment of comparatively untrained men and women. But in so doing we have taken much of the interest out of the work and often made it monotonous.

This subdivision of work is due to our careful study of production methods, and it has come to stay. We are not going back to the old way, for the new is in the line of progress and is better—or can be made so. We must build on the foundation we have laid until the structure is better for all concerned.

We are not going back—we must go on. And this means the putting back of some human interest into work. This is not an easy task; it is more difficult than the subdividing of work, but it can be done. It will be an important factor in production by reducing the turnover of labor and by obtaining a greater spirit of coöperation and loyalty.

We have studied machinery and machine methods to such an extent that we have considered men and women as part of the machinery—that part which could supply certain motions which it was difficult to obtain otherwise. We sometimes planned every move of the hands and feet, prescribed every detail of operation and left the workers no opportunity to exercise intelligence, no matter how much they might possess. This is one of the readjustments which must be made.

There are strenuous years ahead of the machine-building industry, years which will take all the skill, all the intelligence and all the ideas which we can muster. We cannot afford to overlook a single source of supply, to neglect a single opportunity for helpful suggestion. We must utilize all the individual intelligence and skill which are now latent because they have no way in which to express themselves. We ought to have the finest body of workers in the world in the machine-building industry, and we can have it if we realize our responsibility and our opportunities.

The *American Machinist* has been criticized in some quarters for venturing outside of strictly mechanical fields. But as successful manufacturing requires efficient production, and as production depends upon much more than mere mechanical devices, it seems clear that we should not be doing our full duty unless we pointed out and discussed the other factors involved. This is particularly true when we consider that they affect not only the welfare of the machine-building industry but of the whole country.

Together with the rest of the world we are facing new and vital problems. The manager of every machine-building industry must help solve them in the best way for the country and for the world. They cannot be solved without considering more than the mechanical side of the problem.

The Machine-Tool Industry in Germany

THERE are several interesting points in a recent report on the machine-tool industry in Germany by Vice Consul Orsen N. Nielsen of Stockholm, Sweden. Mr. Nielsen quotes Walter Waldschmidt as paying high tribute to the quality of American machine tools and considering them as one of the best of America's products. He states that one-fifth of the manufacturers in this industry in Germany is organized as limited companies, the largest factories employing from two to three thousand men. The association, however, has 280 members and employs between eighty and ninety thousand men, which is from ten to twenty thousand more than were employed in our machine-tool industry during the past year. The average earnings of these companies previous to the war were 6 to 8 per cent.

Mr. Waldschmidt strongly advises a close coöperation between the science and technique of building and says that an attempt was made to form German organization for this purpose in December, 1917. Another step was taken last year, which resulted in the founding of a society for research in scientific manufacturing methods.

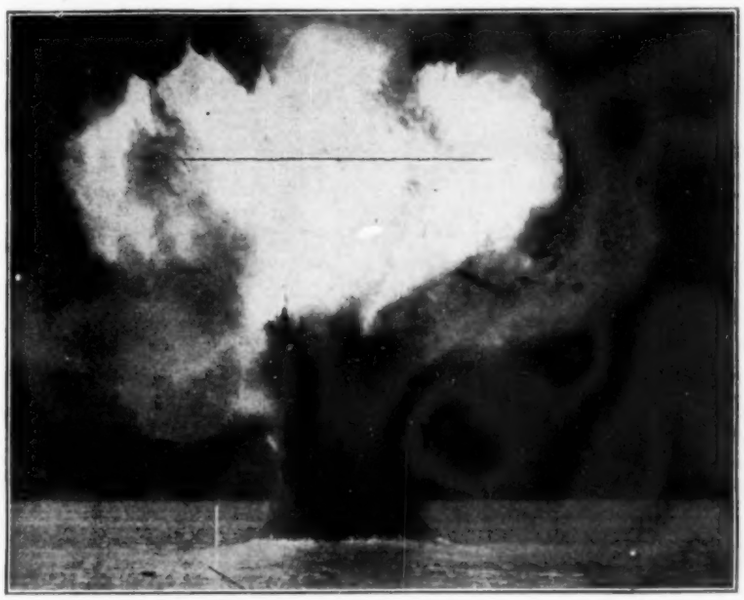
There can be no question as to the advantage of a closer coöperation between the technical schools and the machine-tool builders.

US ARMY ORDNANCE NEWS

History of the Aberdeen Ordnance Proving Ground—I

By MAJ. F. P. LINDH

The story of the conception, authorization and development of the Aberdeen Proving Ground is a striking example of what a peaceful nation can do in the realm of war preparation when it has to. That we waited until war actually overtook us before beginning the project is not much of a recommendation for our foresight, but now that the job is done we have a modern plant that seems adequate to meet any need that might arise in the near future.



A MINE EXPLODED IN BUSH RIVER

SHOULD you happen to be traveling by train or otherwise between Havre de Grace and Baltimore and hear sounds much like a distant thunderstorm it would be a safe bet that you were somewhere near the Aberdeen Proving Ground of the Army Ordnance Department. Here most of the ordnance tests which involve the actual firing of guns of more than 1-in. caliber are conducted. Although there are several other proving grounds their work is of a more or less routine and specialized character or they consist of testing the output of some large manufacturer, but the activities at Aberdeen comprise research and development tests of new guns, gun carriages and ammunition as well as a large number of acceptance tests. Back in 1874 our largest gun was the 15-in. Rodman smooth bore; rifled cannon were still in the experimental stage and high explosives and smokeless powder were only dreams. Even so the existing facilities for testing ordnance at Fortress Monroe were utterly inadequate and it was necessary to appoint a board of officers to select a new proving ground. They eventually recommended the site which we know as the Sandy Hook Proving Ground, although their report shows that they considered it too small and only a temporary expedient. The reservation is on a sandy peninsula about 5 miles long on the Jersey coast and 18 miles from New York.

Some idea of its limitations for modern artillery testing may be gathered from a letter written in 1874 by the commanding officer of the New York Arsenal to the Chief of Ordnance, in which he said: "Ranges from 1500 to 2000 yd. can readily be obtained on this reservation, and if deemed important these distances can be considerably extended within the limits of the reservation." As a matter of fact most of the increase in length of range had to be over water with the attendant danger to shipping and the inability to recover exploded shells to see what actually happened to them. In addition there were the danger to the Fort Hancock personnel, the interference of fog with observations on firing to sea and the vulnerability of the location in time of war. The distance from Washington and from the plants of the big manufacturers was against it and the usually inclement winters interfered seriously with the regular performance of tests.

With the increasing range of the guns and the development of more powerful explosives, conditions became even less satisfactory and the need for a more suitable site became acute. The subject was discussed continually and various attempts were made to obtain some action, but they were without result until early in 1917. At that time a systematic search for a new location was undertaken by the commanding officer of proving grounds, Lieutenant-Colonel Ruggles, and the officers of his staff. They examined many possibilities

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and finally recommended the purchase of Kent Island in the middle of Chesapeake Bay.

When the recommendation was submitted to Congress the existence of a large and prosperous farming industry on the island caused rejection of the proposal, and the present site in Harford County, Maryland, was substituted in the recommendation. Conditions at Sandy Hook were so bad by this time that a $7,000,000 allotment for the purchase and construction of the new proving ground was obtained without difficulty. As it turned out the substitution of the 35,000-acre Aberdeen site for the 16,000-acre one on Kent Island was very fortunate, as the available space in the larger reservation was almost all in use within six months after its inception. The purchase of the land was approved by Congress in October, 1917, and four days later the survey of the reservation began. An extremely severe winter made construction work a heart-breaking task, but it was carried on somehow, and the first shot was fired on Jan. 2, 1918, in a blinding snowstorm. Since then construction and proving have been carried on side by side until now there are quarters available for 8000 men, $10,000,000 have been invested in construction work and 400,000 rounds of minor, medium and major caliber ammunition have been fired. Some idea of the size of the project may be obtained from the fact that in one day 7600 rounds were fired at Aberdeen, more than were fired in a whole year at Sandy Hook.

THE RESULTS OF A PREMATURE EXPLOSION

The reservation extends along the bay shore from Swan Creek, opposite the Susquehanna basin, past Spesutie Island and across the Bush River to the Gunpowder River, a total of about 15 miles. The proximity of the camp to the little town of Aberdeen suggested the name which was adopted.

The barracks, offices and batteries are situated near the northern end of the reservation, leaving the main portion of the grounds clear for firing except that the southern portion of Gunpowder Neck is occupied by the Edgewood Arsenal, a manufactory for poison gas and a large shell-filling plant.

Firing is done on five parallel ranges, each devoted to a particular class of work, which are laid out in a southwesterly direction. This arrangement gives an available range over land of 15 miles, and over water of 40 miles, which is ample for present conditions.

Nearly half of the proving ground is woodland, about a fifth is unwooded swamp and the rest cleared farm land. The country is level and broken up by the tributaries to Chesapeake Bay, and the marshes and weedy flats are a popular winter resort for the wild ducks that have made the bay a hunters' paradise in the past.

The necessity for so large a proving ground is not apparent until one becomes familiar with the scope and diversity of the work carried on. Every new type of gun, gun carriage, projectile, explosive, fuse and a hundred other devices must be rigidly tested before it can be approved for general use. The necessity for making essentially dangerous things safe to handle requires more careful and prolonged testing than is the case with the ordinary manufactured article. Durability must be determined by experiment and final adjustments made by trial no matter how carefully the original calculations were made. To test one gun carriage alone 50,000 shots were fired at Aberdeen, and thousands of rounds are required to test even a single design of fuse.

An entirely different field of operations is opened up when we consider the testing of ordnance material in the production stage to see whether it meets the specifications. No matter how reliable a manufacturer may be his work must be checked up by field tests, for it would be inexcusable to jeopardize the lives of our soldiers by allowing possibly defective ammunition to go untested. The proportion of manufactured ammunition tested is small, usually about one-tenth of 1 per cent., but every gun and gun carriage must be put to the proof individually, and the total volume of these tests during the war exceeded in amount those of development.

Another point to be considered in choosing the site was the desirability of providing sufficient space for each branch of activity to prevent its interference with other branches. Considerable territory had to be provided to fit in a trench-warfare range where a large amount of short-range firing went on, a main battery where nonexplosive projectiles were fired to test powder and guns, a water range where the splashes made by falling projectiles were accurately spotted by observers, several detonating ranges where officers watched bursting shell from bomb proofs close to the line of fire, and recovery fields where shell fired in the morning could be dug up in the afternoon and examined. Add to this an aviation field with shops and hangars, a bombing field where aviators could drop explosive bombs, and an antiaircraft firing range, and there was not

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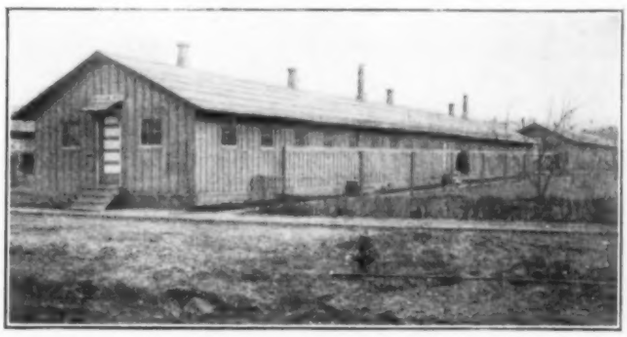
much left after the gas plant was built on Gunpowder Neck. There was no room for a range for testing gas shell, and this work had to be done at a range established for the purpose at Lakehurst.

One other factor had to be taken into account. An antiaircraft shell bursting at 10,000 ft. scatters fragments over a considerable area, while a bursting gun or a big shell striking armor plate may throw pieces of steel a mile or more. If a high-explosive shell ricochets on striking the ground it may be deflected

MACHINE GUNS IN ACTION



A TYPICAL BARRACK

to one side and burst far from the target. While it might be possible to crowd the various proving-ground activities somewhat it is absolutely necessary to protect the inhabitants of the surrounding country by establishing a neutral zone within the reservation. This was done with care and has served its purpose admirably.

PERSONALS

Capt. Hoyle Jones, who left the service recently, was formerly a steel broker in Kansas City, Mo.

* * *

Capt. Thomas F. Frawley, recently discharged, lived in Eau Claire, Wis. He attended the University of Wisconsin.

* * *

First Lieut. Harry A. Tuke, who was formerly employed by the Truscon Steel Co., Youngstown, Ohio, has left the service.

* * *

Capt. Lawrence C. Dehn has been discharged. In civil life he was with Igoe Bros., Newark, N. J., as sales manager.

* * *

Lieut. J. S. Adams of the United States Air Service is now connected with the sales force of C. H. Westerberg & Co., New York.

* * *

Second Lieut. Glenn G. Dudley has been discharged. His home is in Athens, Ore., and he is a graudate of the University of Oregon.

* * *

Capt. Oscar H. Haugan, who was commissioned in June, 1917, has left the service. He was formerly vice president of the State Bank of Chicago.

First Lieut. Clinton C. Van Cise has left the service. He was formerly employed by the New York Telephone Co., 15 Dey St., New York, and is a graduate of Williams College.

* * *

Lieut. A. G. Kessler, U. S. N. R. F., who for six months has been in charge of the Gun Division of the Bureau of Ordnance, Navy Department, has been released from active duty to become vice president of the General Ordnance Co., Derby, Conn., and of the National Tractor Co., Cedar Rapids, Iowa, and will be in charge of purchasing and production at both plants. Mr. Kessler was formerly general manager of the Lakeside Forge Co., Erie, Penn.

* * *

First Lieut. Henry Swift has been discharged. He is a graduate of Boston University and a mechanical engineer. He was employed by the Cincinnati Ball Crank Co., Cincinnati, Ohio.

* * *

Second Lieut. Harold M. Foster, who was discharged on Feb. 18, is a civil engineer and a graduate of Delaware College. He was formerly with the Midvale Steel and Ordnance Co., Wilmington, Del.

* * *

First Lieut. John Mifflin Thomas is a mechanical engineer from the University of Illinois. He was employed by the Electric Bond and Share Co., New York, before entering the service in August, 1917.

* * *

Capt. Garrit S. Cannon has been discharged after 15 months of service. He is a Yale man and in civil life was with the Railway Improvement Co., 61 Broadway, New York, as an executive assistant.

* * *

Lieut.-Col. Charles J. DeWitt has been discharged. He was commissioned Major in November, 1917, and was with the Industrial company, 84 State St., Boston, Mass., as executive. He is an Amherst man.

* * *

Huntly H. Gilbert, who left the service of the Pressed Steel Car Co. and the Western Steel Car and Foundry Co. at the beginning of the war to enter the Army as captain in the Ordnance Department at Washington and later was commissioned major and transferred to

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the Rock Island Arsenal, has reëntered the service of the above-named companies as assistant manager of sales of the western district, located at 425 People's Gas Building, Chicago.

* * *

Capt. Clarence W. Vogt has been discharged. He was commissioned First Lieutenant in June, 1917. He is a Cornell graduate and vice president of Vogt Brothers Manufacturing Co., Louisville, Ky.

* * *

First Lieut. Lyman D. Bothwell, Jr., who was with the Mathews Manufacturing Co., Cleveland, Ohio, before entering the service, has left the army. He was commissioned in June, 1917, Second Lieutenant.

* * *

Capt. George P. Raleigh, who was commissioned First Lieutenant in October, 1917, has been discharged. He is a graduate of Johns Hopkins University and was formerly vice president of the Equitable Trust Co., Baltimore, Md.

* * *

Capt. E. H. Livett, Engineers, U. S. Army, formerly located at Camp A. A. Humphreys, Virginia, has been discharged from the service and is now connected with John A. Stevens, consulting engineer, 8 Merrimack St., Lowell, Mass.

* * *

Maj. Thomas J. Buckley, lately discharged, was treasurer of the Consolidated Fruit Jar Co., New Brunswick, N. J., before entering the service in May, 1917, as captain. He is a graduate of the Stevens Institute of Technology.

* * *

First Lieut. Wesly C. Roche has left the service. He was formerly with the Turner Tanning Machine Co., Peabody, Mass., as mechanical engineer. He will return to his home at Beverly, Mass., but has not determined what work to take up.

* * *

Maj. E. A. Hunt has been discharged. He entered the service in September, 1917, as First Lieutenant. In civil life he was employed by Wheelock, Lovejoy & Co., Cambridge, Mass., as sales engineer. He is a graduate of Lehigh University.

* * *

Capt. Fay B. Williams, who was commissioned First Lieutenant in September, 1917, has been discharged. He attended the Massachusetts Institute of Technology, and before entering the service was employed by the Lamson company, Boston, Mass.

* * *

Capt. John J. Berry, who was discharged recently, entered the service as First Lieutenant in November, 1917. In civil life he was formerly plant superintendent for the American Can Co., New York. He is a graduate of Holy Cross College, Worcester, Mass.

* * *

Capt. Thomas F. Githens, who was commissioned First Lieutenant in November, 1917, has returned to civil life. He was graduated from Columbia University and was employed by the Chili Copper Co., 120 Broadway, New York, as a mechanical engineer.

* * *

First Lieut. Woodward W. Corkran, lately discharged, was commissioned Second Lieutenant in January, 1918. Before he joined the Army the Midvale Steel Co. employed him as assistant to the superintendent. He graduated from the University of Pennsylvania.

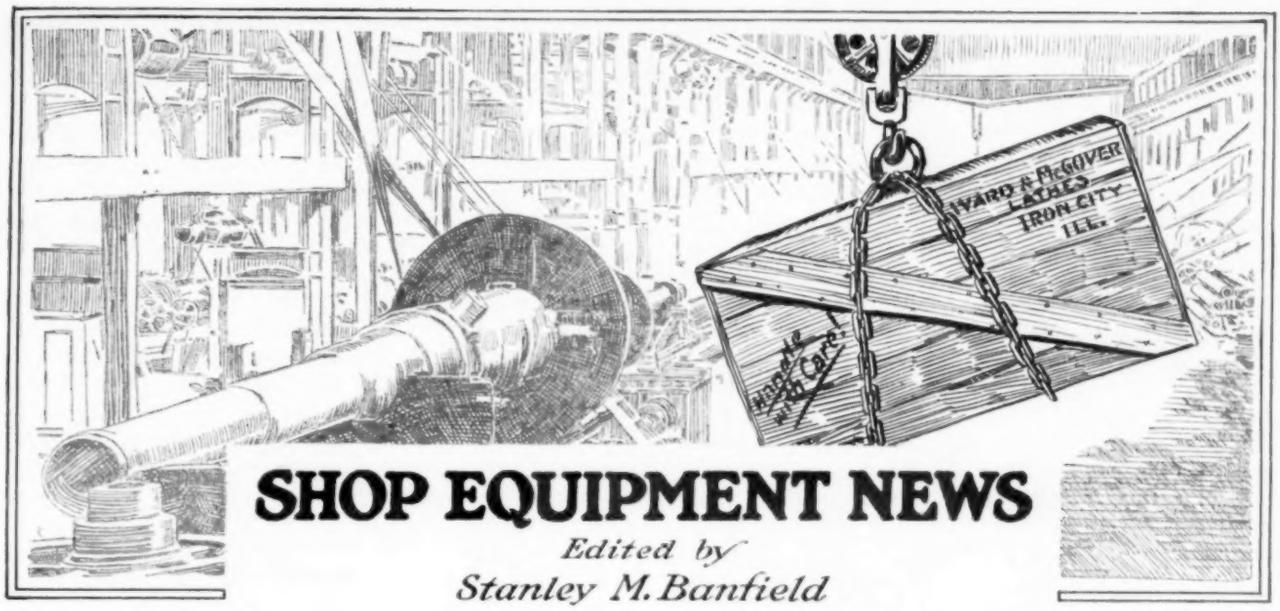
* * *

Thomas Slattery, recently discharged from the Army where he was in the Chemical Research Department, has taken a position as foreman of the electroplating department of the P. & F. Corbin department of the American Hardware Corporation, New Britain, Conn.

* * *

Capt. William C. Marshall went into the service in September, 1917, and was recently discharged. He is a mechanical engineer and a graduate of Yale. He was formerly employed by the Holt Manufacturing Co., Peoria, Ill. He has not yet decided what work he will take up on returning to Milford, Conn.

VISITORS WATCHING 37-MM. GUNS UNDER TEST

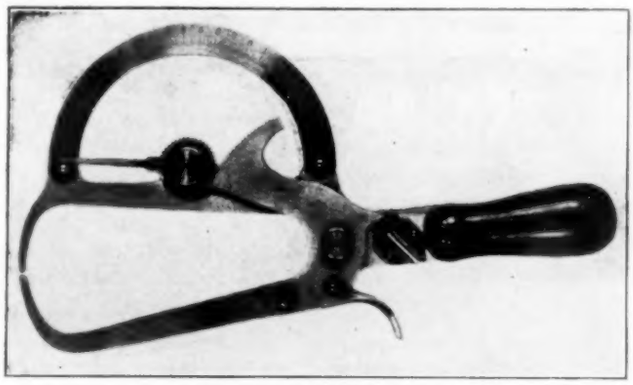


SHOP EQUIPMENT NEWS

Edited by
Stanley M. Banfield

Indicating Calipers

The Indicating Caliper Co., 506 East 19th St., New York City, has just placed on the market the indicating caliper shown, which is made in two sizes, to open 2 and 3 in. respectively, the illustration being of the latter size. The device is fitted with a large handle that fits

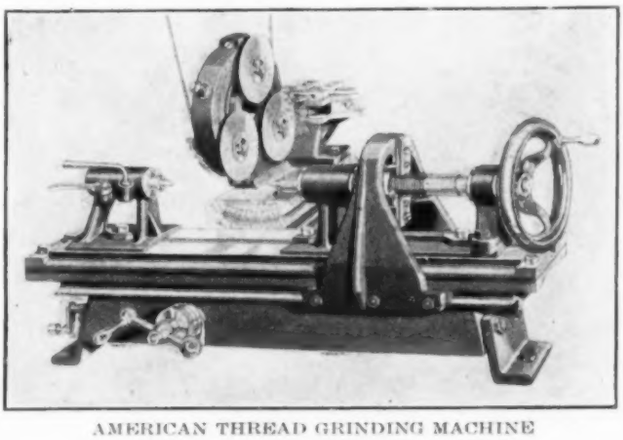


3-IN. INDICATOR CALIPER

into the palm of the hand, while the movable jaw is moved by pressing the trigger with the finger. When the points separate, a geared segment operating on the small gear wheel carrying the pointer causes this pointer to move over the graduated scale, indicating the distance between the points. A spring coiled in the barrel of the pinion actuates the pinion and the hand which is attached to it and draws the points of the caliper together. This constant pressure from one side eliminates any backlash and errors due to this cause. The part containing the movable jaw and the geared segment is set on ball bearings in a milled raceway, effecting an easy movement of the mechanism and the elimination of shake. At the bottom of the sector is a spur, and slightly below a nut which holds an adjustable screw bearing against the spur. This permits the adjustment of the points to the desired distance, allowing the opening of the points beyond the distance set, but preventing closing below this measurement until the screw is withdrawn. The indicating hand is fastened at two points—the lower over the pinion center and the upper in the projection on the pinion. The hole in the upper fastening is elongated, permitting compensation for any wear of the gear teeth, it being possible to make this adjustment in a few moments. The movable point of the caliper is attached in the geared segment by a screw and two pins, and various shaped points may be attached for special uses. The 2-in. caliper is graduated to read to hundredths of an inch, every tenth graduation being marked with a numeral, and the fifth intervening graduation being made longer to facilitate reading. The 3-in. caliper is graduated in sixty-fourths, every eighth mark representing an inch.

American Thread-Grinding Machine

The thread-grinding machine shown in the illustration has just been placed on the market by the American Thread Grinding Machine Co., 814 Gates Ave., Brooklyn, N. Y., and a number of unique features are claimed for the device. It will be noticed that three grinding wheels are carried on a head, which is the turret type. The wheels are positioned by means of the stop shown at the front of the turret while this is clamped by means of the screw shown at the top. By mounting the three grinding wheels, as shown, it makes it unnecessary to go through the changing operations customarily neces-

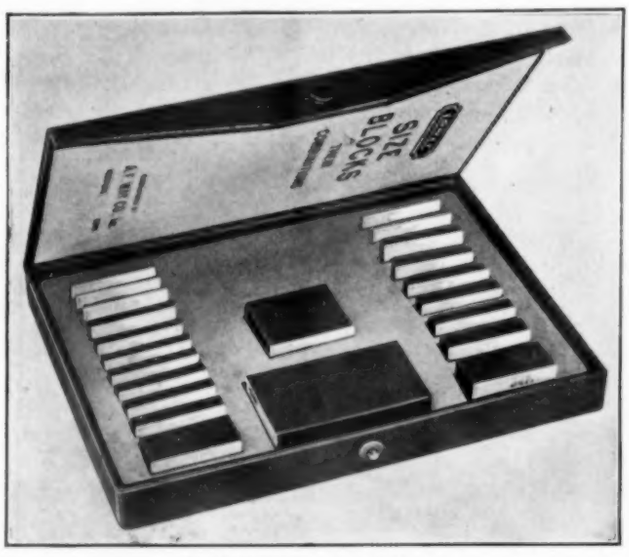


AMERICAN THREAD GRINDING MACHINE

sary in changing from roughing to finishing or changing to a wheel of different grade. It will be noticed that the turret carrying the three grinding wheels is mounted on a cylindrical shaped base, this construction making it possible to tip the wheel to the helix angle of the thread. A dressing fixture is located at the rear behind the wheels, it being the idea to true the wheel not in use while the actual grinding is being done. The truing device is provided with graduations, so that the diamond can be adjusted to the desired angle. The base carrying the wheel turret is also provided with graduations, so that it can be quickly set to the desired helix angle. The work is held between centers and is revolved by means of the handwheel at the right, this also serving to give the proper feed to the work. It will also be noticed that this wheel carries a master screw and is fixed to the main carriage in regard to longitudinal position. The arch carrying the nut engaging the master screw is fixed to the base of the machine, and when the master screw is turned it causes the sliding carriage to move under the arch and give the proper feed to the work. The handwheel shown at the front of the bed is used for feeding the grinding wheels to the work and is provided with a graduated dial. When a new piece of work is set up it is of course necessary to adjust it so that the wheels are in proper position along the longitudinal axis of the piece, and this is accomplished by means of the small adjusting handle shown projecting from the left side of the bed below the slide.

"Loway" Size Blocks

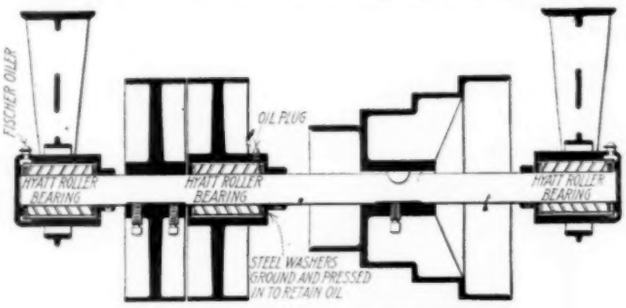
The A. F. Way Co., Inc., Hartford, Conn., has just placed on the market a new line of size blocks, the idea being to provide a set of blocks that are within the reach of every mechanic for his own personal use. They are made of selected material, and with the exception of sizes below 0.0937 in. are heat treated, hardened and seasoned. Blocks are ground and lapped a trifle over the exact dimensions, which bring them within the commercial limits of accuracy for the majority of work. It is stated that all blocks measure between their rated size and 0.0001 in. oversize, thus making the combined error of five blocks only 0.0005. Each size of block is marked with a letter for identification, and each set is furnished with a combination chart in which the various combinations obtainable are given with their letter equivalents, this table showing at a glance the necessary blocks to make up any required measurement. The blocks are put up in three sets. Set A, which is the one shown, combining sets B and C, consists of 21 blocks, including the 1-in. and 2-in. blocks and having a total over-all measurement of 6.293 in.; set B consists of 13 blocks in fractional dimensions, starting with $\frac{1}{64}$ in., it being possible to measure in steps of $\frac{1}{64}$ up to $4\frac{19}{32}$ in.; set C consists of 11 blocks in decimal equivalents, starting with a 0.025 in. and measuring in steps of 0.025 in. up to 4.825 in. The blocks are intended for the general run of machine-shop work only, and are not supposed to be used in competition with the various types of precision gage blocks now on the market.



"LOWAY" SIZE BLOCKS

Queen City Roller-Bearing Countershafts

All shaping machines hereafter placed on the market by the Queen City Machine Tool Co., Cincinnati, Ohio, will be equipped with a roller-bearing countershaft as shown in the cut. Ball bearings on the countershafts are of the Hyatt roller type and Fischer oilers are used. The cross-section illustration shows the construction of the device quite clearly.

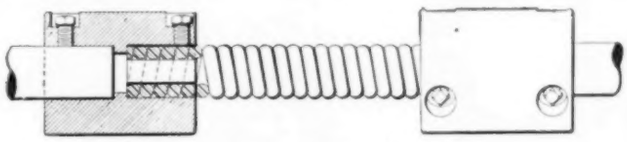


ROLLER-BEARING COUNTERSHAFT

"Karge" Cushion and Flexible Couplings

The Three Rivers Machine Tool and Die Corporation, Phœnix, N. Y., has recently placed on the market the "Karge" cushion and flexible couplings, one type of the former being shown in the illustration. These devices are constructed of special alloy-steel coils terminating in couplings by which they are fastened to the ends of the solid-steel shafting. Cushion couplings are intended to be employed as a regular coupling in connecting up line shafts or to be inserted immediately ahead of heavy-duty machines to serve as a buffer or cushion and lessen the starting strains on motors. These couplings also take care of misalignment of the shaft up to 1 in. The flexible couplings are very similar to the cushion couplings except that a longer coil is used, permitting a continuous line of shafting to be carried over or under obstructions or around a corner, from one floor to another or even down one side of a partition wall and back on the other side without the use of gears or belts. Line shafting may be erected in haste over uneven surfaces without regard to align-

ment. Three different methods are used at present for connecting the couplings, the one illustrated making use of the ordinary type of setscrews. In the second type a split sleeve is used, one end screwing over the coil spring while the other end fits over a solid-steel shaft, the compression being obtained as in the ordinary compression coupling. It will be noticed that a solid steel plug is used inside of the end of the coil spring in order to prevent its decreasing in outside diameter when the compression is applied. The third method

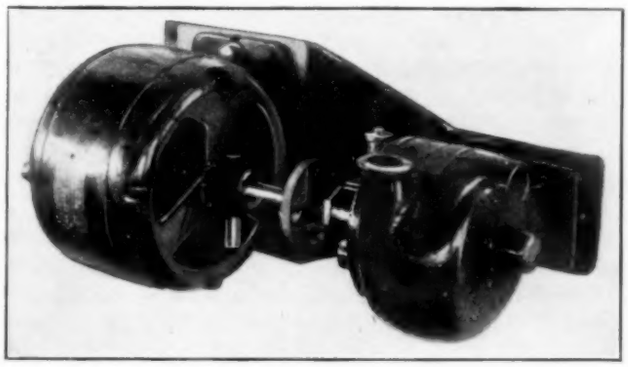


"KARGE" FLEXIBLE SHAFT COUPLING

of holding is to insert a steel plug inside of the coil spring and then shrink a sleeve on the outside, a keyway being cut in the outside of the sleeve to serve as a fastening. All couplings are made of cast iron and the compression sleeves of steel. It is the practice to make the inside diameter of the coil spring the same as the outside diameter of the shafting it is used to connect. When constructed in this manner the couplings are claimed to have 30 per cent. more strength in torsion than the solid-steel shaft. The devices are at present made in varying sizes for shafts from ½ to 6 in. in diameter.

"Fulflo" Motor-Driven Pumps

The motor-driven lubricant pump shown in the illustration is one of a line that has just been placed on the market by the Fulflo Pump Co., Blanchester, Ohio. These pumps are built in ¾, ¾, 1 and 1¼ in. sizes arranged for either floor or wall mounting and are equipped with ⅙, ⅓, ¾ and 1 hp. motors respectively. The pump shown in the illustration is the ¾-in. size equipped with a ⅓-hp. motor running 2700 r.p.m. The capacity of this machine at this speed is 21 gal. per minute with an 11-ft. head, 20 gal. per minute with a 12½-ft. head, and 11 gal. per minute with a 24-ft. head, cutting compound being used. The pumps are of the centrifugal type and, having both intake and outlet located at the top, retain enough fluid for priming purposes without the aid of valves or other mechanical means. The impellers are of the semienclosed type and



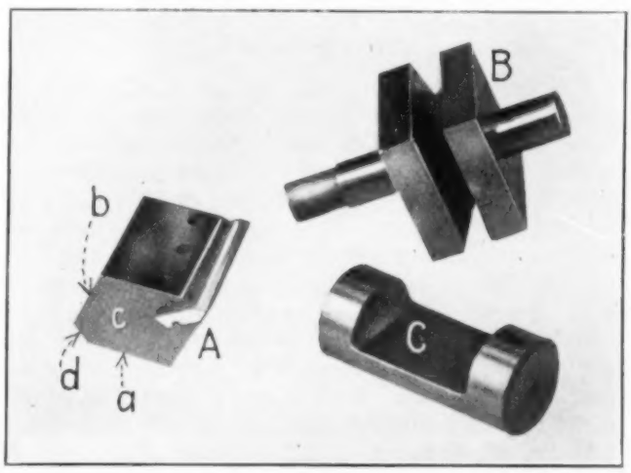
FULFLO ¾ IN. MOTOR-DRIVEN PUMP
Length, 19⅜ in.; width, 8 in.; height, 9¼ in.; weight complete, 58 lb.

are supported by a bearing at either end of the impeller shaft, the thrust on the suction side of the impeller being taken care of by a hardened-steel thrust collar on the shaft, which turns against the nose of the bronze bushing supporting the impeller shaft on the suction side of the pump. The main pump bearing also forms the pump gland and is of cast iron. The lubrication of this bearing is taken care of by a sight-feed oiler which feeds into a pocket completely surrounding the bearing. The shaft is hardened and ground and the packing used is of the flexible metallic type. It is claimed that the life of the pump is exceptionally long in that the impeller does not depend upon any contact fits for its pumping efficiency. Standard pumps have cast-iron bodies, covers and impellers, but may be furnished in brass or bronze if desired. The base is arranged for a three-point mounting, which enables it to be leveled without the necessity of machining the surface to which it is to be attached. The pump is attached to the base by six screws, three of which extend through the motor and pump base and three through the motor base only, the pump base resting on their points. This construction makes it possible, by adjusting these screws, to bring the pump into line with the motor. after which the screws are locked in place.

Arrow Thread Tool Accessories

Making precision threads requires that the utmost care be exercised in every step of the process, and at no point is this more necessary than in the preparation and setting of the tools with which the threads are cut. Three devices for the accurate grinding and setting of threading tools are shown in the illustration.

At *A* is a jig for grinding the ordinary form of tool used in the P. & W. holders for cutting threads of 60-deg. included angle. The tool is held in a suitable groove by three headless setscrews, and the angles



GAGES FOR GRINDING AND SETTING THREAD TOOLS

formed by the intersection of the planes of the various surfaces are such that all faces of the tool may be ground without moving it in the jig.

With the jig resting on the surface *a* as shown in the picture, either on the magnetic chuck of a surface grinding machine or on the elevating table of the common form of tool-grinding machine, one angular face of the tool may be ground, and turning the jig to rest on

surface *b* the opposite angle is brought into position. Setting the jig on surface *c* the tool is ready to be ground on the top to the correct angle, while resting it on surface *d* enables the operator to remove the apex of the angle to conform to the United States Standard form of thread. The width of the flat can be accurately computed from micrometer measurements taken over the surface *d* and the apex before and after grinding.

At *B* is a setting gage with grooves of four different angles. This tool is usually made round—as a matter of convenience in making—and is serviceable for but one form of thread, but when made square as this one is it can be made to accommodate four forms. This gage has grooves of 60-deg. angle for setting U. S. and V tools, 29 deg. for the Acme form, 55 deg. for Whitworth and 53 deg. 8 min. for Loewenherz threads.

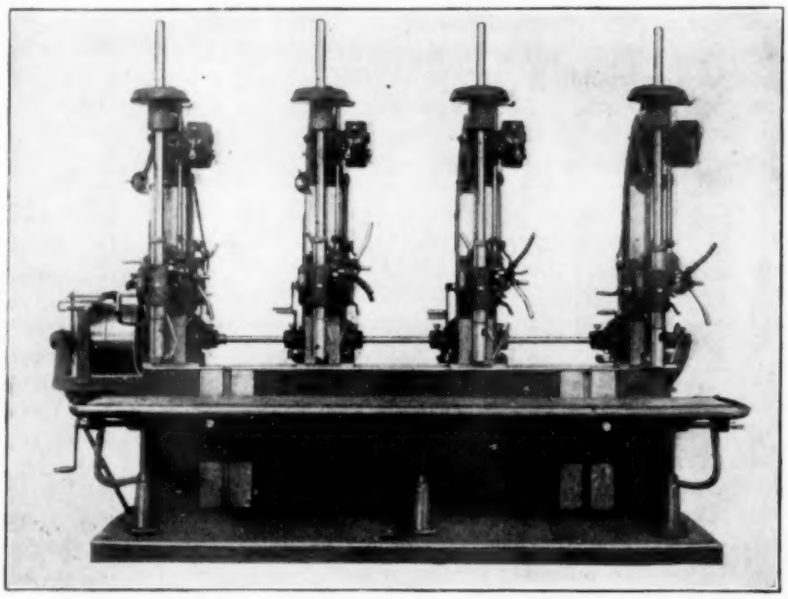
In use it is mounted on a mandrel, as shown, and placed between centers in the lathe. It is necessary to bring the face to be used to a vertical position by squaring from the shears of the lathe, in which respect it is less convenient than the round form, but this lack of convenience is more than offset by the greater utility of the tool.

Before setting the threading tool to gage *B* the gage *C* is used to bring the top of the tool exactly to center.

The flat surface of this gage cuts the center line, consequently when the gage is on centers and turned with the flat surface down a correctly set threading tool will just barely pass under it. These tools are the product of the Arrow Tool Co., 200 Cannon St., Bridgeport, Conn.

Barnes Adjustable-Head, Gang Drilling Machine

The Barnes Drill Co., 814 Chestnut St., Rockford, Ill., has just placed on the market a new 26-in. adjustable-head, gang drilling machine of the four-spindle type. One of the chief features of this machine is the lateral adjustment, which gives a spindle range from 18 in. minimum between any two adjacent spindles to a maximum of 96 in. between the two outside spindles. The first spindle at the left next to the driving pulley is fixed, but the other three may be adjusted in a lateral direction. The machine is all-geared, having no cones or inherent belts whatsoever except the driving belt from the line shaft. There are eight geared speeds and eight geared feeds for each spindle and all are independent of one another. The method of driving each spindle is as follows: On the driving shaft at the rear there is a bevel gear driven by an expanding friction clutch and controlled by the vertical lever shown at the left side near the base of each head. Thus the spindle may be stopped or started by throwing the clutch out or in without shifting the change-speed gears. On account of the lateral adjustment it is necessary to have counterweights for the sliding heads and spindle outside of the column, and the counterweight chain is brought over sheave wheels so that these weights hang back of the bridge construction back brace. The particular machine shown was provided with oil-pump attachment for delivering the cutting lubricant to the work on the table, there being two reservoir tanks to take care of the larger supply of cutting lubricant for the heavy-duty machine. The capacity of this gang is up to 2 in. solid drilling in steel and it will bore out cast-iron cylinders up to 8 in. in diameter.



BARNES FOUR-SPINDLE, 26-IN. GANG DRILLING MACHINE

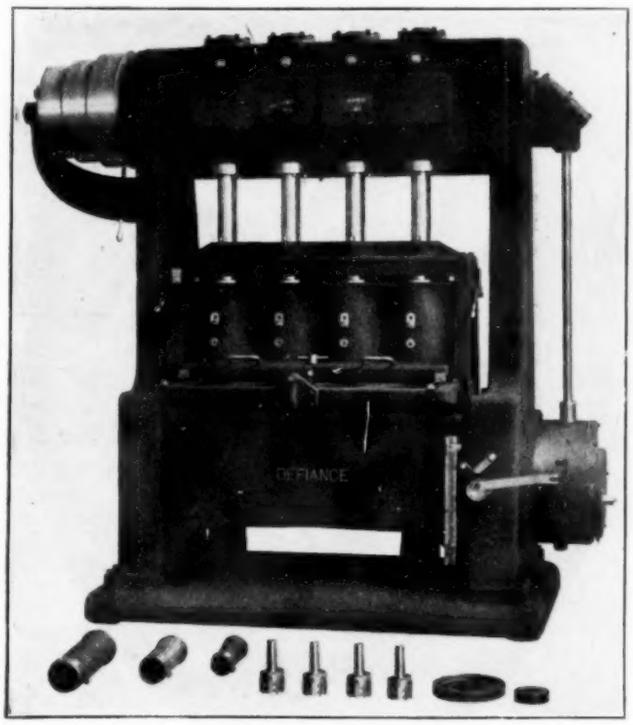
Defiance Cylinder-Boring Machine

The Defiance Machine Works, Defiance, Ohio, has just placed on the market a line of cylinder-boring machines, one of which is shown in the illustration. These are single-purpose production machines and are very similar except in size, the No. 7 machine taking 36 in. between housings, the No. 8 machine 48 in. between housings and the No. 9 machine 60 in. between housings. The machines are for rough boring, semifinish boring or finish boring gas-engine cylinders of either single units or with any number of units cast en bloc.

The drive to the spindle is transmitted from a three-step cone pulley through steel worms and bronze worm gears, but instead of following the common practice of securing the worm gears to the spindles by means of keys large tongues are cut integral with the spindles, the worm gears being cut out to fit. The spindles are made of hammered stock and each one is supported by three bronze bearings. The nose bearing is conical in shape and has a convenient means of adjustment for wear. All end thrust is taken care of by SKF ball bearings, of which there are two for each spindle. The momentum of the spindles can be overcome and a quick stop made after the power has been turned off by means of a friction brake located in the drive pulley and set with a lever located within easy reach of the operator. The boring tool is fitted to the spindle by means of a tapered shank and is held securely in place by means of a long bolt passing up through the spindle to the top, thus eliminating any possibility of the tool being extracted from the spindle on the return feed.

The feed mechanism is of unit construction to afford easy access and is tightly incased, retaining sufficient oil to effect a splash system of lubrication. All the feed-shaft bearings are bronze bushed, while end thrust is taken by SKF ball bearings. Feed changes are made by removing the gear-case cover and changing two gears. A hand adjustment for the table is provided, but when in operation the table feeds the work to the boring tools automatically, and when the cut has been finished a fast travel reverse is automatically thrown into action, returning the table to and stopping at the loading position.

The oiling system is a particular feature of the machine and consists of force feed and splash system com-



DEFIANCE CYLINDER-BORING MACHINE

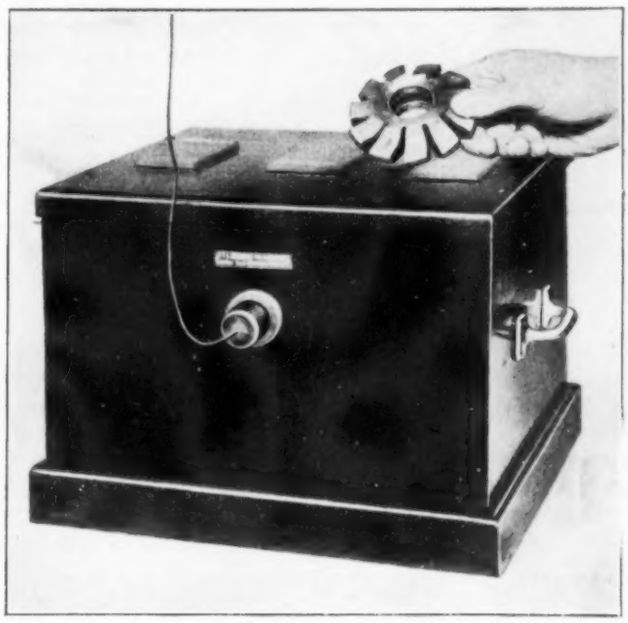
bined, made possible by the all-inclosed feature of the machine. Both the feed and drive mechanisms are tightly inclosed and partly submerged in a bath of oil, while the bearings are lubricated through individual leads from a force-feed arrangement. Unit construction of the various mechanisms is followed throughout, and each unit is accessible without disturbing other parts of the machine.

Jack screws are used for raising and lowering the table, each screw being actuated by a heavy worm and worm gear through a bronze nut which is sleeved to the worm gear. Each jack is a unit in itself and its contents are packed in grease to insure thorough lubrication. A means for advancing or retarding the screws independently is also provided in order to maintain perfect alignment of the table, and all thrusts are taken on SKF ball bearings. The advantage of having a jack screw feed which is located directly beneath the work is said to lie in obtaining an absolutely vertical feed thrust, thereby eliminating all side thrust on the table, which is said to be a very important factor in obtaining work bored round and in vertical alignment. The table, columns and base constitute the frame and are of cast iron. The table is gibbed to the columns on each side. The columns and the base are of box construction reinforced. The base rests on the floor at three points only, thus eliminating the necessity for a concrete or other foundation of this type.

Extra attachments, such as motor drive, holding fixtures and tools, and equipment for cutting compounds or lubricants, including pump, tank, and pipe fittings, are furnished as extras.

"Bulldog" Demagnetizer

The Electric Brazing and Welding Machine Co., Inc., 30 Church St., New York City, has just placed on the market the "Bulldog" demagnetizer shown in the illustration. The purpose of this machine is to demagnetize cutters, flat tools, gages, rings, bearings, etc., that have been magnetized by being placed on magnetic



"BULLDOG" DEMAGNETIZER

chucks or by other causes. The device is intended to be attached to the ordinary electric-light circuit and the only operation necessary to demagnetize a piece of work is to pass it over or between the pole pieces as shown in the illustration.

"Little Niagara" Pumps

The Hudson Pump Co., Inc., 17 Merseles St., Jersey City, N. J., has recently placed on the market the "Little Niagara" machine-tool lubricant pump shown in the illustration. The device is at present made in two sizes, No. 0 and No. 1, having capacities of 5½ and 11 gal. per minute respectively. Fig. 1 shows an outside view of the pump and Fig. 2 a cross-section giving an idea of the construction of the device. The idea in bringing forth this pump was to provide a device with a large delivery at slow speed and containing no parts such as check valves, springs, gears, sliding blades, etc. The piston is made from a single casting having two openings, one on each end, these being larger than the suction or discharge to eliminate the possibility of clogging. The piston is driven by the rotor and the ends

FIG. 1. "LITTLE NIAGARA" LUBRICANT PUMP

Size 0—Capacity, 5¼ gal. per minute; pipe size, ⅜ in.; size of pulley, 3½ in.; belt width, 1 or 1¼ in.; weight of complete pump, 12¾ lb.; extreme length, 8¼ in. Size 1—Capacity, 11 gal. per minute; pipe size, 1 in.; pulley size, 4 in.; width of belt, 1¼ or 1½ in.; weight of complete pump, 23 lb.; extreme length, 10¼ in.

being machined at an angle impart a back-and-forth motion that gives the pumping action. The unique feature is the fact that the flow can be reversed with

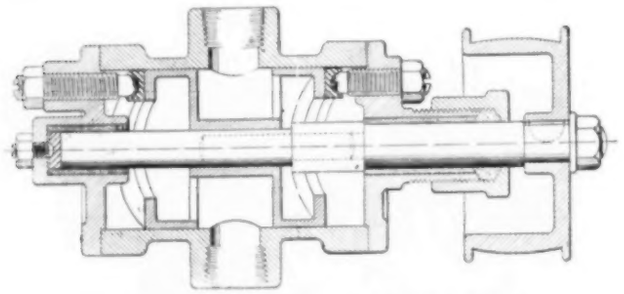


FIG. 2. CROSS-SECTION OF THE PUMP

the pulleys running in the same direction by simply turning the heads of the pump 180 deg. The pump is so made that any wear on the end of the piston can be compensated for by means of the adjusting screws.

"Tip-It" Welding Compound for Stellite

The "Tip-It" welding compound for Stellite that was described on page 1146, Vol 49, and on page 46a, Vol. 50, and which was said to be a product of the Haynes Stellite Co., Kokomo, Ind., is being manufactured by Tip-It, Inc., 120 Broadway, New York.

Jones Superior Gear-Hobbing Machine—Erratum

In the articles on the Jones Superior gear-hobbing machine on pages 275 and 328a an error was made. The work arbor and hob arbor can be brought within four inches of each other and the minimum diameter of gear that can be cut depends upon the size of the hob. The company states that gears as small as 4 or 5 in. in diameter can be cut if necessary.

How Should These Tables Be Placed?

A contributor would like to get an expression of opinion from the readers of the *American Machinist* as to the best arrangement of the tables in a drafting room where daylight illumination is used. If the light comes from side windows (not overhead), should the tables face the windows or not?

George Kinne Garvin

George Kinne Garvin, president of the Garvin Machine Co., Spring and Varick Sts., New York, died at his residence in Garden City, L. I., on Feb. 20, after a brief illness.

Mr. Garvin, who was a prominent figure in engineering circles, was born in May, 1859, in Hartford, Conn., where his father, the late Hugh Garvin, was contractor in Colt's Armory.

After the Civil War the elder Garvin started in business in New York, the firm name being Smith

GEORGE KINNE GARVIN

& Garvin. George received his education at Hasbruck's Institute, Jersey City, N. J., and after leaving school worked for a time in his father's shop, which in the meantime had been moved to Bricksburg (now Lakewood), N. J., eventually succeeding to the management of the business.

Mr. Garvin was a prolific inventor and made many improvements in machine tools, some of which are in use in all parts of the world. He possessed a genial disposition and last spring and summer befriended many of the soldiers passing through Camp Mills on Long Island.

Two of his sons, George K., Jr., and Frank W., are with the American Expeditionary Forces in France, while the other two, Burr K. and Hugh R., are connected with the Garvin Machine Co.

Mr. Garvin left a widow and six children and he is also survived by a brother, F. W. Garvin.

He was a member of the Engineers' Club, the American Society of Engineers and the Garden City Club.

LATEST DEVELOPMENTS IN THE AUTOMOTIVE INDUSTRIES

Aircraft • Motor Trucks • Tractors

Increasing activity is noticeable in the steel trade due to the large purchases of the automobile trade. According to estimates more than 90 per cent. of the business now being done at the mills is in sheets for the automobile industry.

An air record was established by Capt. Roy N. Francis in a Glenn-Martin bomber when he flew from Washington to New York with four passengers in 2 hours and 15 min. The distance of 240 miles was covered at an average of 107 miles an hour.

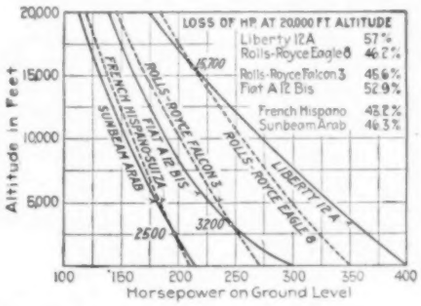
Sales figures of the United States Tire Co. indicate that the drift toward the use of large pneumatic tires on light trucks instead of solid tires has become noticeable. The company believes that the time is near when the accepted tire equipment for such trucks will be pneumatic.

The Army Aeronautic Corps has been successful in establishing communication between an airplane in the air and a regular telephone on the Washington city line. The conversion of radio to direct-wire communication was made automatically by an apparatus devised by Army officers.

The Eisemann Magneto Co., Brooklyn, N. Y., has a new type of combined magneto and generator for tractor use. The magnets in the magneto are horizontal instead of vertical. The generator is superimposed on the magneto so that it can be easily removed whenever necessary without interfering with the ignition magneto. In this way the tractor can continue its operation should any trouble occur to the starting or lighting generator.

That the abandonment of the De Haviland 4 planes for use in mail service was due to structural defects is clearly indicated by the issue of a bulletin by the Post Office Department asking bids for 17 changes in the planes. These include reinforcing the longerons and splices with steel and plates, enlarging wires and fittings, reinforcing sides of fuselage and bulkheads, landing gear to be strengthened and moved forward and other equally important changes. When it is considered that combat planes are subjected to greater stresses than any other the changes ordered by the Post Office Department are all the more significant.

The values of power losses given by the Technical Section of the Division of Military Aeronautics and compiled in the diagram shown afford a direct comparison of the power losses at various altitudes between the Liberty 12-A and the Rolls-Royce Eagle 8, Rolls-Royce Falcon 3 and Fiat A-12 bis, and the French Hispano-Suiza and Sunbeam Arab airplane motors. The 400-hp. Liberty 12-A shows superiority in power over the Rolls-Royce Eagle 8 350 hp. motor up to the altitude of 15,700 ft. Above this height the Rolls-



Royce gives more power, and at 20,000 ft. its superiority is approximately 16 hp. The power losses at 20,000 ft. are 57 per cent. for the Liberty engine and 45.6 per cent. for the Rolls-Royce. At approximately 3200 ft. the 270-hp. Rolls-Royce Falcon 3 has the same power as the 297-hp. Fiat A-12 bis, and from this altitude up to 20,000 ft. it has an average superiority in power of 7.6 hp. The 208-hp. French Hispano Suiza, while losing 43.2 per cent. of its power at the height of 20,000 ft., proves to be superior to the Sunbeam Arab 217-hp. motor above 2500 feet.

Looking back on the great tractor-manufacturing program of last year it seems to be worth while for the material-specialty manufacturers to produce some wear-resisting material to meet the requirements of such wearing parts as bull gears, pinions, sprockets, transmission gears, shoes, links, pins, lugs, spacing blocks, chains, rollers, etc. The use of manganese or other alloys in the construction of these parts or for parts which are adaptable to tractor usage is being advocated by some for the heavily loaded tractor wearing parts. Another manufacturing opportunity would seem to be in the investigation of the possibilities for the use of pressed-steel products in tractor construction. A big demand has been created for pressed-steel parts rather than for cast or malleable iron in the construction of practically all kinds of machinery, particularly in the various automotive lines.

Agreement between automobile and pneumatic tire manufacturers to remove all war restrictions on sizes and styles of tires was announced by the National Automobile Chamber of Commerce. There are, however, many advantages in keeping the number of sizes and styles as low as possible.

The United States Senate and House have agreed upon the Post Office Appropriation Bill, including $200,000,000 for federal aid to highways and $300,000 to continue experiments with motor-truck transportation of parcel-post mail matter. This will be reflected in the building of all kinds of machinery.

A special building for motor cars has been erected at the great industrial fair at Lyons, France. Here several post-war models of foreign cars, chiefly of French and Italian makes, will be exhibited. America will be represented by the B. F. Goodrich Rubber Co., the United States Rubber Co. and the Willys-Overland Company.

There is a tendency among tractor manufacturers to adopt a compressed-air starter as a regular tractor equipment. This is not so much because the electric starter is not reliable but because the principles of electric apparatus of this kind are not so generally understood by dealers and farmers. This was well illustrated in the recent tractor investigation held by the United States Department of Agriculture. It has been found that a large per cent. of all tractor troubles originated in the ignition systems on account of the lack of knowledge on the part of users.

Aircraft contracts totaling $469,000,000 have been canceled or suspended by the War Department since the signing of the armistice. During the week ended Feb. 7 about $2,000,000 worth of airplanes and engines were delivered, leaving orders still to be filled valued at $10,000,000. On the day hostilities ceased outstanding orders for service planes aggregated $125,000,000. Up to Feb. 7 about 91 per cent. of these contracts had been canceled. The total production of Liberty motors to Feb. 7 was 20,147 with 331 still to be delivered. Contracts for 30,526 Liberty motors were outstanding Nov. 11, 1918, but orders for 23,622 were canceled. The production of the De Haviland planes up to Feb. 7 was 4600 exclusive of 204 shipped without motors. There are still 42 planes of this type to be delivered.

Sparks from the

Shipping Board Reduces Cost of Tracings

Mechanical Reproductions Hard to Distinguish from Originals—Cost But Fraction of Latter

By means of a recently patented process the Emergency Fleet Corporation has been producing at a cost of from 10 to 13c. per square foot tracings which if made by hand would ordinarily cost from $1.50 to $5 per square foot. The resulting tracings from this process are so nearly like the original that they are distinguishable as reproductions only on close inspection.

The table shows the amount of tracings delivered and the cost for the week of Dec. 5-12, 1918. A similar table submitted for the week of Oct. 17-24, 1918, shows 1137 sq.ft. at a cost of 12.9c. per square foot. Besides the simple operation of reproducing tracings either on cloth or paper the process has been used in a number of other

WEEKLY REPORT OF LITHO ROOM, DEC. 5-12, 1918

Number of men in room	2
Original tracings received	417
Process tracings made	1681
Number of plates of jelly poured	36
Number of square feet of tracing cloth used	2566
Number of square feet of tracing cloth delivered	2460
Number of square feet of tracing cloth wasted	106
APPROXIMATE EXPENSE OF SECTION FOR SEVEN DAYS	
Cost of tracing cloth	$137.25
Miscellaneous supplies and jelly	29.00
Supervision	60.00
Labor	16.00
Total expense	$272.25
APPROXIMATE COST PER SQUARE FOOT	
Labor per square foot	$0.019
Materials and supervision	0.093
Total cost	$0.112

ways and for a variety of purposes. It has been used for progress work, the reproductions, either on cloth or strong paper, being used instead of blueprints or Vandykes. It has also been used to produce new drawings, a large part of which are similar to those previously made, by blocking out the parts to be changed on either the transfer print or on the plate, with the new details drawn in by hand.

The work is done in the following manner: A matrix blueprint on a special transfer paper is made on any good blueprint apparatus, but it is not developed or washed before its use in the process.

When at the proper temperature a sensitized gelatine is poured over a zinc plate, usually 42 x 98 in. or 42 x 110 in., which rests on an inclined, adjustable table, the proper thickness of gelatine being obtained by the angle of inclination of the table and by the special pouring pot designed for the process. The overflow is caught and used again. As soon as the gelatine is poured the table is righted and the gelatine allowed to set a few minutes.

AN ESSENTIAL TREATMENT

From the adjustable table the gelatinized plate is put into a recess of a patented refrigerating table and undergoes the essential treatment on which the success of the process depends.

After a few minutes in the refrigerator the plate is placed, gelatine up, on the refrigerated top of the table, its temperature being maintained at the 60 deg. limit of efficiency. The unwashed matrix print is laid face down on the gelatine for a few seconds, which on removal leaves the reversed image on the gelatine, a reaction having taken place between the unexposed lines of the transfer print and the sensitized gelatine.

The gelatine plate is then inked with a squeegee roller spread with special carbon ink which clings only to the lines left by the transfer-print reaction, being repelled by the rest of the gelatine.

FINISHED TRACING IN 30 MINUTES

The paper or cloth on which the tracing is desired is then laid smoothly on the gelatine, pressed flat and immediately taken off, the complete tracing being transferred to the finest line. As many as 10 to 15 impressions may be made on tracing cloth from one gelatine plate, merely by reinking, and 40 to 60 copies reproduced on paper. The finished tracing is then complete and can be used within a short time.

The time from the transfer print to the finished tracings was 30 min. or less. Pouring and refrigeration of plates are so controlled that no delay occurs at any stage of the process, and although the stated limit of capacity for a one-table plant is 500 sq.ft. a day actual results, as shown by the table, have been greater than this.

* * *

Italian Machinery Imports

In the Feb. 6 issue of the *American Machinist* under the heading of "Italian Machinery Imports" a news item was published stating that an association of important firms had been formed at Milan, Italy, to carry on trade in industrial machinery and machine tools from allied countries. This item was taken from *Commerce Reports* of the Canadian Department of Trade and Commerce, which stated that such an organization had been formed under the name of Italian Association of Importers and Merchants, Milan, Italy.

Work of the Forestry Section of Engineer Corps in France

For use in producing lumber and timber products for the American Expeditionary Forces there has been produced and shipped to France 46 logging locomotives, 550 log cars, 200 miles of rail and 600 complete small-type sawmills with accessory logging outfits.

The banner month in production for these mills was October, 1918, when they cut 50,000,000 ft. of lumber. Plans were well under way for the manufacture of 100,000,000 ft. of lumber a month by January, 1919, and this figure would undoubtedly have been reached, as the men were becoming expert, roads were improving and in general conditions were in every way more favorable. Up to Nov. 30, 1918, the lumber produced by the sawmills operated by the Forestry section, Corps of Engineers, for the use of the American Expeditionary Forces would build enough barrack buildings 20 ft. wide to extend if placed end to end 600 miles and house 3,107,600 men. The standard-gage railroad ties produced would build a line of single-track railroad 1091 miles long, or from St. Nazaire to Berlin via Tours and Paris. The small ties for 24-in. track would build double tracks paralleling 185 miles of trenches. The pickets, posts and poles if cut into 6-ft. posts would make a fence with posts a rod apart reaching one-third the distance around the earth. The piling if stood end to end would make a flagpole 435 miles high. The wood fuel produced would make a rick 1 yd. wide, 1 yd. high and 600 miles long, or as cord wood a rick 4 ft. wide, 4 ft. high and 340 miles long.

* * *

Russian Central Union of Coöperative Societies Explained

The bulk of Russia's buying power exercised by 80,000,000 people through the membership of 20,000,000 families in 30,000 coöperative societies forming 500 provincial unions is concentrated in the All-Russian Central Union of Co-operative Societies.

As a means of establishing direct contact with forward-looking manufacturers of high-grade standard products the Central Union has opened a buying agency in America, to procure machinery and supplies where available quickly, advantageously and in quantity.

Controlling vast stocks of raw materials produced in Russia and Siberia the Central Union desires to promote on a large scale commercial intercourse with America.

The American representative is Alexander Zelenko, Liebes Building, 167 Post St., San Francisco, Calif.

World's Industrial Forge

By E.C.Porter
News Editor

Sixth National Foreign Trade Convention

The chairman of the National Foreign Trade Council, James A. Farrell, has issued the formal call for the Sixth National Foreign Trade Convention to be held in the Congress Hotel, Chicago, on Thursday, Friday, and Saturday, Apr. 24-26, 1919.

This year, says Mr. Farrell, the convention has assembled a large amount of valuable technical information, which is available to all delegates who wish to use it. This information will be furnished by the volunteer trade advisers of some of the most experienced business houses and by the representatives of the Government trade agencies. A number of prominent business men of long experience in every branch of foreign trade have offered their services as volunteer advisers. The information they can give is based on personal experience and as such is doubly valuable. In addition the Department of State will coöperate by assigning to the convention some members of the consular service who will just have returned from Europe, Latin America and the Far East. The Department of Commerce will send a number of its experts from the Bureau of Foreign and Domestic Commerce. The Shipping Board will be represented. The Pan-American Union will be present to give information on Latin-American relations. These men are thoroughly familiar with their respective fields and can supply a great fund of valuable information if called upon.

* * *

A Method of Treating Burns

Surgeons used to consider that the sealing up of infected burns—and the majority of burns are infected—was contrary to all sound surgical principles. However, the successful treatment of burns by sealing them up with a neutral wax has made it easy to forget former theories and ideas.

Dr. Barthe de Sandfort, now a retired surgeon of the French navy, has made encouraging progress over a period of years in the treatment of burns by sealing them up with certain paraffines and resinous gums, thus protecting the delicate nerve endings that were exposed and allowing the body heat so confined to aid nature in repairing the injury.

Dr. de Sandfort's experiments have resulted in a special preparation of wax called Ambrine, which is now manufactured under his formula in the United States as well as in France. Briefly his treatment is as follows: The burn should be washed with distilled water or a mild antiseptic, such as a boric or saline solution; all blisters should be punctured and allowed to drain naturally, and the burn should be thoroughly dried by an electric drier fan before Ambrine is applied.

In applying Ambrine it should be melted by heating in a water bath and the heat brought to and maintained at about 150 deg. F. It should then be sprayed by an atomizer over the entire surface of the wound and at least one-half inch over the edges. Over this should be applied a very thin layer of medicated absorbent cotton while the wax is still soft, and on top of this another coat of Ambrine should be sprayed or brushed so that the whole will form a solid crust. After this the burn should be heavily padded and bandaged in the usual manner.

In a short time secretions form under the dressing, rendering the wax nonadhesive so that it can be readily removed without pain or injury.

The burn should be re-dressed every 24 hours until the granulating area shows only slight secretions, when the dressing need only be removed every 48 hours.

Ambrine can be used successfully not only with superficial burns, but with burns of the second and third degree. The advantages claimed are: painless application and dressing, almost instant relief from the pain from the injury and rapid healing with very little scar tissue.

No less an authority than Dr. William O'Neill Sherman, chief surgeon of the Carnegie Steel Co., says in *Surgery, Gynecology and Obstetrics* that Ambrine is in use in all the company's emergency hospitals and they have treated with it more than 3000 cases of burns. He further says: "It is useless to compare this method with any other method because of its undoubted superiority. It is an ideal treatment for burns."

* * *

Election of Officers

The American Institute of Consulting Engineers, Inc., New York, at its council meeting on Feb. 5 elected the following officers: L. B. Stillwell, president; A. M. Hunt, vice president, and F. A. Molitor, secretary and treasurer. At the annual meeting the following members of the council were elected to take the places of those retiring: S. Whinery, Desmond FitzGerald, J. Parke Channing.

* * *

Exports From Canada

During the past year the declared exports from Ottawa, Canada, to the United States were valued at only $40,074,709, as compared with $320,458,636 in 1917.

Kiln-Drying Methods for Airplane Stock

Tests Conducted by Forest Products Laboratory Show Superiority Over Air-Drying Method

A summary of results obtained at the forest products laboratory of the Forest Service is contained in a report of the director of the laboratory to the forester, Forest Service, United States Department of Agriculture.

At the time our aircraft program was launched practically no seasoned spruce stock was available. To air-dry green spruce 3 in. thick, such as is used in airplanes, requires from one to two years. The forest products laboratory specified a method of kiln drying by which green-spruce airplane stock can be dried in from 20 to 40 days to the proper moisture content. Kilns were designed for the Army and Navy and for commercial companies capable of properly drying airplane stock, and men were furnished to operate them until operators could be trained at the laboratory. Seasoned stock was thus insured equal, if not superior, to air-seasoned material.

A relatively slight advantage in lightness and strength over the best substitute makes spruce the preferred airplane wood and warranted the organization of a Spruce Production Division. The same importance attaches to any saving in strength, however slight, that is accomplished through proper methods of seasoning. Exhaustive tests are showing that the Forest Service specifications produce better material than can be obtained by drying in the air.

Strength of Airplane Woods

Over 300,000 tests made on about 130 species of wood afforded basic information for aircraft design. From these data the relative suitability of various species of wood, the influence of defects, the relation between strength and density and the influence of moisture can be determined. A table of strength values at 15 per cent. moisture was prepared by the forest products laboratory, and adopted by the Army and Navy as a basis for the design of the wooden parts of aircraft.

Practically all airplane specifications for lumber and parts accepted by both the Army and Navy were either prepared or reviewed by the Forest Service.

The relative strength of various woods was investigated. The results obtained were used as bases for determining the best substitutes for spruce and also in eliminating undesirable species.

The inspection of wood has played a greater part in the manufacture of air-

craft than in any other industry, and at the beginning of the war the number of men qualified to undertake such a responsibility was very limited. The laboratory assisted in educating men for this work, first by preparing an inspectors' handbook on wood and later by instituting regular courses in wood inspection.

TESTS OF BEAMS AND STRUTS

On account of the difficulty in obtaining suitable pieces for manufacturing the larger airplane parts and the necessity for conserving material several series of tests were conducted at the laboratory on built-up beams and struts of various designs and also on various types of splices. Present specifications of the Army and Navy for laminated and spliced beams and laminated struts are based on the results of these tests.

A waterproof coating for airplane propellers, which incorporates thin aluminum leaf in the finish, was developed at the laboratory and placed in production by the War Department.

Direct assistance was given by the laboratory in stimulating the production of the materials needed for making waterproof glues as well as the manufacture of the glues themselves, and a number of concerns were aided in developing satisfactory manufacturing procedure.

Several types of waterproof glues, both of the blood albumin and casein types, were worked out and were demonstrated to certain manufacturers upon request of the Bureau of Aircraft Production. One of these types is now obtainable in the open market.

NEW PLYWOODS DEVELOPED

Practically nothing was known of the mechanical and physical properties of plywood at the beginning of the war. The use of plywood in aircraft construction necessitated information of this kind, and the properties of plywood of many species were determined by the laboratory through elaborate series of strength tests.

The aircraft work of the Army and Navy Departments covers a much broader field than would seem possible at first thought. The results of real value that were obtained are many in number and far-reaching in application. At the time the armistice was signed production was increasing rapidly.

* * *

A New Bronze-Alloy in Norway

A captain in the Norwegian navy, Mr. Bull, has invented a new bronze-alloy, the so-called M-bronze, which is particularly adapted for bearings, armaments and machinery parts where a comparatively high hardness is required, and for welding and rolling. In order to satisfy different requirements the bronze is worked out in three qualities: One hard (M H), one medium hard (M M) and one soft (M B). For use where an especially good quality is demanded and for ship's use there can also be produced a finer quality, like mangan bronze.

New Process Gear Corporation Taken Over by a New Organization

The Meachem Gear Corporation, of which T. G. Meachem is president, T. W. Meachem vice-president and J. F. S. Meachem treasurer, Syracuse, N. Y., has been incorporated for the purpose of taking over from the New Process Gear Corporation the manufacture of New Process rawhide pinions and for the general manufacture of gears of all kinds. The company is incorporated at $300,000 and has purchased a three-story building at 411-415 Canal St., Syracuse, which is to be devoted entirely to the manufacture of gears.

The Meachems who organized this company are the same persons who owned and controlled the New Process Gear Corporation and the New Process Rawhide Co. for 30 years. Associated with them are George W. Wood, secretary and superintendent, and H. W. Kiddle, assistant superintendent, who had charge of the manufacture of rawhide and the rawhide-pinion department of the old company.

The plant purchased was remodeled and began operation on Mar. 1, at which time it took over the rawhide-pinion business, the hide plant at 811 Free St., and all of the raw materials and uncompleted orders pertaining to this branch of the business.

The company will also manufacture a full line of cut metal gears for mills and factories of all kinds.

* * *

Engineers' Club of Philadelphia to Hold Interesting Meeting

Dr. John A. Brashear will present an illustrated paper entitled "An Evening's Journey among the Stars" at the regular meeting of the Engineers' Club of Philadelphia at Witherspoon Hall on Tuesday evening, Mar. 18, 1919.

A special meeting will be held at the club house, Wednesday, Mar. 12, 1919. Prof. Warren P. Laird, Department of Architecture, University of Pennsylvania, will present an illustrated paper on "The Placement of the Delaware River Bridge."

The club has made preliminary announcement of a special meeting on Wednesday, Apr. 23, at which Arthur J. Baldwin, vice president of the McGraw-Hill Co., Inc., will present an illustrated paper on "The Devastated Area and Its Reconstruction."

* * *

Cincinnati Machine Tools in Spain and Portugal

Cincinnati sells more machine tools to Spain and Portugal than all the rest of America combined, declared Henry S. Moos, president of the American Machinery Syndicate of Madrid, Barcelona and Bilboa (Spain) and Lisbon (Portugal), who made a business visit to Cincinnati recently.

"Since the beginning of the war Spain has become a manufacturing country," said Mr. Moos, "and now is making most of the commodities she formerly imported. Cincinnati is particularly well known in our country by reason of the superior machinery manufactured here, as well as the excellence of other products, such as soaps, leather goods, tools, hardware, etc. Some idea of the high esteem in which your machine tools and other machinery are held in Spain may be gained from the fact that when contracts are let for any sort of machinery in Spain the specifications almost invariably call for 'Cincinnati-American' machines.

"During the past year Spain purchased more than $2,000,000 worth of machine tools and machinery in Cincinnati. Most of this is being used to build other machinery in Spain."

* * *

Annual Exhibit at Pratt Institute

Thursday evening, Mar. 13, will be observed as visitors' night in the school of Science and Technology of Pratt Institute, Brooklyn, N. Y. From 8 to 9 o'clock the shops, laboratories and drawing rooms of the school will be open for the public to observe the students at work.

* * *

Books for Reconstruction Hospitals

The remarkable range of the reëducation program for disabled soldiers is shown by a list of books for reconstruction hospitals received by the *American Machinist*. It has been compiled by the American Library Association in support of the work of the Surgeon-General's office, and 150 subjects are covered.

Trades and occupations are fully treated in the list, giving the best American books which are neither too elementary nor to specialized for vocational purposes. Some of the books on machine-shop practice contained in the list are on airplane mechanics, blacksmithing, brazing and soldering, electrical engineering, engineering, machine-shop work, advanced mathematics, metal finishing, patternmaking, sheet-metal work, technical periodicals, trades and occupations.

Many of the books are now in the American Library Association libraries in reconstruction hospitals. Any book on the list is supplied to the hospital, where the librarian finds that the specific need for it exists.

* * *

Will Divide Profits With Employees

Announcement is made by John H. Schumann, president of the Hilo Varnish Corporation (formerly Moller & Schumann Co.), Brooklyn, N. Y., of a profit-sharing plan.

Mr. Schumann states that half the profits of the corporation will be distributed among all the employees annually; that each will receive a share proportionate to his salary or wages and the length of time he has been on the payroll of the corporation.

Export Opportunities

W. Rakers, 21 Chineesche Voorstraat, Sourabaya, Java, would like to establish connections with American exporters of tools, hardware and machinery.

Briscoe & Co., Ltd., Crawford and Bond Sts., Dunedin, N. Z., are importers of steel bars and plates, wire rope, etc., and invite correspondence with American manufacturers.

Juan Ortoll Delmotte, Santa Cruz, Teneriffe, Canary Islands, wishes to obtain exclusive representation of American lines of motor cars and accessories, hardware, wire and nails.

Joseph Boukez et Cie., P. O. box 604, Alexandria, Egypt, general importers specializing in chemicals, iron and steel, cement and building materials, desire to represent American lines.

Osaka Boeki Kaisha, Ltd., Osaka, Japan, solicits correspondence with American dealers in chemicals and metals with the object of obtaining Japanese and Korean representation of American lines.

Mohamedally Abdoolally & Co., Iron Jatha, Carnac Bridge, Bombay, India, are desirous of handling American lines of galvanized, corrugated and plain sheets, steel angles, tees and plates, hoops, pipes and pipe fittings.

Horne Co., Ltd. is the new name of F. W. Horne & Co., a Japanese corporation recently purchased from F. W. Horne by the American International Corporation. The business will be continued along its present lines.

A. & T. Burt, Ltd., Dunedin, N. Z., general importers and exporters, are particularly interested in machinery and fittings, engineering requisites, lighting fixtures and similar lines. Correspondence with a view to handling American goods is solicited.

Personals

GEORGE W. TRAUT, president and treasurer of the Traut & Hine Manufacturing Co., was presented with a silver loving cup in honor of his 50th birthday. The presentation was made by General Superintendent E. N. Humphrey.

R. G. AMES has joined the Black & Decker organization in the capacity of branch manager in charge of the Chicago office. Mr. Ames is well known in the automobile-accessory trade, having been associated for the past 10 years with the Edward A. Cassidy Co., New York.

A. F. STRAFER, recently with the Kemp Machinery Co., has organized the Strafer Machinery Co. in Baltimore, Md. Mr. Strafer has been identified with the machine-tool business for a number of years and was formerly with the Motch & Merryweather Machinery Co., Cleveland.

ROBERT S. ALTER, vice president and foreign manager of the American Tool Works Co., was given a dinner at the Business Men's Club, Cincinnati, Ohio, Jan. 31, 1919. The principal speaker was E. G. Todd of E. Isbecque & Co., New York, Brussels and Antwerp. Mr. Alter was presented with a gold watch.

L. M. BAKER is now special engineer of the Hyatt Roller Bearing Co., Detroit, Mich. Formerly Mr. Baker was sales manager of the United Motors Service, Inc., where he was chiefly engaged in organization and expansion work. Previous to this connection he was Western sales manager of the Standard Steel Spring Co., Detroit.

N. A. BOOZE, for a number of years secretary of the Machinists' Supply Co., has joined the Federal Machinery Sales Co., 12 North Jefferson St., Chicago, the change taking effect Feb. 17. Mr. Booze was one of the organizers of the Machinery Club of Chicago, served as its secretary and is among those responsible for its successful start.

THEODORE R. HUGO is the new superintendent of the Lisk Manufacturing Co., Bridgeport, Conn., according to an announcement issued by the company. Mr. Hugo comes from the Liberty ordnance plant of the American Can Co., Bridgeport, which he managed for the past year. Previous to that he was superintendent of the American Can Co.'s plant in Geneva.

Business Items

The Independent Pneumatic Tool Co. will move its New York office from 170 Broadway to larger quarters at 1463 Broadway in the near future.

The J. R. Stone Tool and Supply Co., Detroit, Mich., will represent the Advance Tool Co., Cincinnati, in Michigan. It will carry a full line of Advance tools in Detroit.

The National Twist Drill and Tool Co., Detroit, Mich., has opened a salesroom and office at 565 West Washington St., Chicago, Ill. E. J. Chamberlain is in charge.

The Chicago Pneumatic Tool Co. has removed its Cleveland office from room 813 to rooms 406-408, Engineers' Building. Ross Watson, district manager, will be in charge.

The Logansport Machine Co., Logansport, Ind., will in the future devote its factory entirely to the production of Logan air chucks, a line that contains many new features in air-chuck construction. George F. Hopkins, formerly superintendent of the Frost Gear and Forge Co., Jackson, Mich., has been appointed works manager. The Frank G. Payson Co., 9 South Clinton St., Chicago, Ill., has been granted exclusive selling rights for the United States and for foreign countries.

Obituary

HOWARD P. EELLS of Cleveland, for 15 years prominently identified with the National Metal Trades' Association, of which he was president from 1909 to 1911, died at Pasadena, Calif., Feb. 11, at the age of 63. Mr. Eells was born in Cleveland and graduated from Hamilton College in 1876 and from Harvard University in 1877. For many years he was president of the Bucyrus Co., South Milwaukee, Wis., and at the time of his death was chairman of the board of that company. Previous to holding the presidency of the National Metal Trades' Association he served for some time as treasurer and as one of the councillors of the association. He was president of the Dolomite Co., Cleveland, director of the Sandusky Cement Co., Sandusky, Ohio, and director and member of the executive committee of the Superior Savings and Trust Co., Cleveland.

New Publications

Drafting Room Methods: Standards and Forms.—By Charles D. Collins. One hundred and forty-nine 5½ x 8¼-in. pages; numerous forms and tables; bound in red cloth boards. Published by D. Van Nostrand Company, 25 Park Pl., New York. Price $2.

This book has been written with the intention of giving those responsible for drafting-room organization something definite on which to found their system and make it as near standard as possible. Although a comparatively small book the information in it is in a very condensed form and to the point. The book is divided into four parts. Part I deals with the drafting room, and is subdivided into Location; Equipment; Personnel; Methods of Handling Work; Filing; General Instructions. Part II deals with Standards and Symbols, and the subdivisions are Safety Standards; Abbreviations; Aëronautical Terms; Cross-Sections; Definitions; Electrical Symbols; Lines; Patent Office Symbols; Pipe-Fitting Symbols; Rivet Symbols; Structural Materials—Breaks; Thread and Tapped Holes; Topographic Symbols. Part III is on Forms, and the subdivisions are Form Sizes; Drawing Sizes; Application Blank; Arrangement of Drawing; Building and Equipment Record; Print Record; Pattern Record; Index Cards; Material List; Specifications; Organization Chart; Rubber Stamps; Titles; Work Schedule; Work Orders. Part IV is devoted to Miscellaneous Tables listed as follows: Bolt Stresses; Bolts and Nuts; Bolt Threads; Washers; Weight Steel Bars; Studs; Pipe Threads—Briggs; Pipe Sizes; Boiler Tubes; Pipe Flanges; Pipe Fittings; Keyways; Shafting Horsepower; Gages—Sheet; Gages—Wire; Metric Conversion; Weights and Measures; Decimal Equivalents; Areas and Circumferences of Circles.

American Methods in Foreign Trade.—By George C. Vedder. First edition, 196 pages. Published by the McGraw-Hill Book Co., Inc., 239 West 39th St., New York. Price, $2 net.

The aims of this volume are to familiarize American business men with export selling methods and are based on an experience and observation of the author's 14 years' connection with the export trade. Starting with the fundamentals he outlines the general practices now in existence and strongly advises the carrying out of the ideals which have built up American industry and discourages the imitation of European, especially German, trade practices.

The 33 chapters in this valuable work thoroughly outline the functions of the export manager, selling agent, manufacturer and commission house, also sales and advertising plans that are noteworthy for

their practicability. National questions, such as a viewpoint on the Webb-Pomerene bill and the working of the American merchant marine, are covered.

Cost Accounting.—By J. Lee Nicholson and John F. D. Rohrbach. Five hundred and seventy-six 5¾ x 8¼-in. pages; 102 forms; bound in black limp leather. Published by the Ronald Press Co., New York. Price, $6.

Cost accounting as a vital factor of successful business administration, has in the last few years been brought home in various ways to many manufacturers who before had never seriously appreciated its importance. The Federal Trade Commission, working for more stable conditions, has conducted a widespread campaign of education, explaining in detail what a cost accounting system is, how it is operated and the resulting business advantages. Various manufacturers' associations first paid skilled accountants to devise cost-finding methods suited to their special trade conditions, and then instituted a vigorous propaganda to induce all engaged in their own particular industry to adopt them. In this way they could obtain uniform methods in the trade and a uniformity of selling prices and the end of reckless and ignorant price cutting. The Government, in its need to levy heavy taxes with its consequent necessity for searching investigations into income and excess profits, requires that estimates and approximations as to production costs and profits shall give place to accounting systems giving actual figures obtained by uniform methods. As a result of this pressure and the attention given accounting in the better class of schools cost accounting has become the rule in all well-conducted businesses.

With the needs of those seeking authoritative cost-accounting data in mind the authors have compiled this book. Their efforts have been directed first to classifying the details of cost accounting so that the reader, whether accountant, manufacturer or student, is given a well-defined idea of the forms and records required for each separate operation, and an idea of how these forms and records fit into the general system used in the establishment with which the individual is associated. Secondly, they have endeavored to present additional and specially important data, such as a comprehensive table of depreciation rates and the classification of and distinction between assets and perishable tools. Definite information of this kind based on standard practice solves many problems which arise when such arbitrary matters as depreciation and classification are left to individual judgment with its tendency to be biased by the current statement of profit and loss. Similar problems have arisen in interpreting the terms of numerous Government contracts made during the war period and their subsequent cancellation. For this reason the book is brought up to date by a detailed discussion of what may be chargeable to such contract work and what compensation the contractor may be entitled to on the cancellation of a fixed price, a fixed profit or a cost-plus contract.

The various individual chapters deal with Cost Finding and Its Functions; Elements of Cost; General Methods of Cost Finding; Department and Product Classification; Factory Orders; Material and Material Reports; Wage Systems; Labor Reports; Departmental Application of Overhead; Depreciation and Maintenance; Distribution of Factory Overhead; Factory Overhead Reports; Methods of Reporting Production; Cost Sheets; Stock Records; Summarizing Records—Charging Factory Expenditures; Cost-Summarizing Records—Transfers Within the Factory; Cost-Summarizing Records—Sales, Cost of Sales and Journal Entries; General Ledger Control of Factory Accounts; Factory Ledger Controlling Accounts; Financial and Factory Statements; Method of Taking Inventory; Plant Asset Records; General Considerations; Installing a Cost System—Examination of Plant; Installing a Cost System—Method of Starting Operations; Elementary Cost Systems; Estimating Cost Systems; Uniform Cost Methods; Recommendations of Interdepartmental Cost Conference; Cost-Plus Contracts—Material, Labor and Equipment Items; Cost-Plus Contracts—Expense and Overhead Items; Suspension or Cancellation of Contracts.

The various forms and charts cover Elements of Cost; General Methods of Cost-Finding; Factory Orders; Material and Material Reports; Labor Reports; Factory Overhead Reports; Production Reports; Cost Sheets; Stock Records; Summarizing Records; Controlling Accounts; Financial and Factory Statements; Inventory Records; Estimating Costs; Cost-Plus Contracts.

Trade Catalogs

Loway Size Blocks. A. F. Way Co., Inc., Hartford, Conn. A single-sheet circular giving description and price of different sets of size blocks.

Loway Sine Bar. A. F. Way Co., Inc., Hartford, Conn. This four-page circular shows how the sine bar is used. The price and an illustration are given.

Leyner Oil Furnace, No. 3. Ingersoll-Rand Co., New York. Form 9120. Catalog. Pp. 4; 6 x 9 in. Giving advantages, construction and essential details of this furnace.

Dixon's Graphite Products. Joseph Dixon Crucible Co., Jersey City, N. J. Catalog. Pp. 20; 3¼ x 6¼ in. This describes the various products of the Joseph Dixon Crucible Company.

The Sergeant Ticket Cancelling Box. Ingersoll-Rand Co., New York. Form 9010. Catalog. Pp. 4; Giving particular advantages, diagram of the mechanism and a list of users of the Sergeant ticket-cancelling box.

Class F-P Steam Engine. Ingersoll-Rand Co., New York. Form 9026. Catalog. Pp. 12. On the Ingersoll-Rand high speed piston-valve steam engine. There are cross-sectional illustrations showing the machine in detail.

Imperial Tie Tamping Outfits. Ingersoll-Rand Co., New York. Form 9123. Catalog. Pp. 24; 6 x 9 in. It is profusely illustrated and shows the application of the tie-tamping outfit on many of the important railroads in the United States.

The Oliver Sawing, Filing and Lapping Machine. Oliver Instrument Co., Adrian, Mich. Catalog. Pp. 24. This combination sawing, filing and lapping machine is here described and illustrated. Details of the special features and specifications of its various types are also given.

Snyder Drilling Machine. J. E. Snyder & Son, Worcester, Mass. 1919 Catalog. Pp. 42; 6 x 9 in. This new catalog illustrates and describes high-grade upright drilling and tapping machines. General dimensions and details are given of the different types of machines manufactured by this company.

Tractor Service Book. Gurney Ball Bearing Co., Jamestown, N. Y. Booklet. Pp. 24; 4 x 9 in. The information presented herein will be found of interest in connection with the use of tractors. Useful engineering data are given, together with several blank service-account form records.

Geared Marine Steam Turbines. De Laval Steam Turbine Co., Trenton, N. J. Bulletin M. A 32-page catalog describing standardized geared turbine units for marine service. Details of construction of turbines and gears and also various turbine-driven auxiliaries, including lighting sets, circulating pumps, boiler feeders, etc., are given.

Erie Steam Hammers. Erie Foundry Co., Erie, Penn. Catalog F. Pp. 40; 8½ x 11 in. This is an illustrated catalog giving descriptions, specifications and instructions for erecting, operating and adjusting the various types of steam hammers. It also describes Erie trimming presses and sheet-galvanizing and shearing machinery.

Equipment for Sugar Factory and Refinery Service. Ingersoll-Rand Co., New York. Form 9028. Catalog. Pp. 18; 9½ x 11 in. Touching briefly on the various machines manufactured for this class of service. The catalog is offered in both English and Spanish, and can be had free on request at any of the Ingersoll-Rand Co.'s offices.

Small Power Drives, No. 16. Morse Chain Co., Ithaca, N. Y. Catalog. Pp. 24; 6 x 9 in. This is the fourth publication of the series, "A Chain of Evidence." It is composed largely of half-tone illustrations showing the installation of Morse silent chain drives in factories, mills, power plants, etc. On the inside back cover is a table of data to be used in the design of Morse silent chain drives.

Cubic-Foot Standard for Gas. Technologic Paper 114, Bureau of Standards, Department of Commerce, Washington, D. C. A paper treating of a new type of cubic-foot standard for measuring gas, which possesses decided advantage over the apparatus of this type commonly in use at present. The standard is especially well adapted to the needs of traveling inspectors of gas-meter testing apparatus. This paper is now ready for distribution, and those interested may obtain a copy by addressing a request to the bureau.

Catalog 7. Graton & Knight Manufacturing Co., Worcester, Mass. Pp. 124; 6 x 9 in. An illustrated catalog showing the different processes of belt making from the receiving of the hide to the finished belt. It not only illustrates and describes the different products made by Graton & Knight, but shows what can be accomplished in the manufacture of high-grade leather belting and leather specialties. The belting section fully explains the capabilities of the company's brands of belting, and embodies mechanical rules, tables and other information that should be of value in determining the most efficient belt for any drive or in assisting in other transmission problems. The last 20 pages are devoted to the leather-strap and sundries department and describe the miscellaneous products manufactured under this head.

Catalogs Wanted

Alexander Zelenko, American representative of the All-Russian Central Union of Coöperative Societies, Liebes Building, 167 Post St., San Francisco, Calif., would like to receive catalogs and price lists in duplicate from subscribers and advertisers who desire to establish commercial relations with the above societies.

Forthcoming Meetings

The annual aeronautical exposition of the Manufacturers' Aircraft Association, Inc., will be held Mar. 1 to 15 in New York.

The annual meeting of the National Foreign Trade Council will be held at Chicago, Apr. 24-26.

The annual convention of the United States Chamber of Commerce will be held at St. Louis, Apr. 28-May 3.

The National Metal Trades' Association will hold its 21st annual convention at the Hotel Astor, New York, Apr. 23 and 24.

The Engineers' Club of Philadelphia will hold its regular meeting at Witherspoon Hall, Tuesday evening, Mar. 18, 1919. Announcement has been made of a special meeting on Apr. 23, at which Arthur J. Baldwin, vice president of the McGraw-Hill Co., Inc., will speak.

The annual meeting of the American Association of Engineers has been scheduled for May 13 at Chicago.

Boston Branch National Metal Trades Association. Monthly meeting on first Wednesday of each month. Young's Hotel. Donald H. C. Tullock, Jr., secretary. Room 41, 166 Devonshire St., Boston, Mass.

Engineers' Society of Western Pennsylvania. Monthly meeting, third Tuesday; section meeting, first Tuesday. Elmer K. Hiles, secretary, Oliver Building, Pittsburgh, Penn.

New England Foundrymen's Association. Regular meeting, second Wednesday of each month. Exchange Club, Boston, Mass. Fred F. Stockwell, 205 Broadway, Cambridgeport, Mass.

Philadelphia Foundrymen's Association. Meeting first Wednesday of each month. Manufacturers' Club, Philadelphia, Penn., Howard Evans, secretary, Pier 45, North Philadelphia, Penn.

Providence Engineering Society. Monthly meeting fourth Wednesday of each month. A. E. Thornley, corresponding secretary, P. O. Box 796, Providence, R. I.

Rochester Society of Technical Draftsmen. Monthly meeting, last Thursday. O. L. Angevine, Jr., secretary, 857 Genesee St., Rochester, N. Y.

Superintendents' and Foremen's Club of Cleveland. Monthly meeting, third Saturday. Philip Frankel, secretary, 310 New England Building, Cleveland, Ohio.

Technical League of America. Regular meeting, second Friday of each month. Oscar S. Teale, secretary, 240 Broadway, New York.

Western Society of Engineers, Chicago, Ill. Regular meetings, first, second, third and fourth Mondays of each month, except July and August. Edgar S. Nethercut, secretary, 1735 Monadnock Block, Chicago, Ill.